SECOND EDITION

HANDBOOK OF
Psychology

VOLUME 7
Educational Psychology

William M. Reynolds
Gloria E. Miller
Volume Editors

Irving B. Weiner
Editor-in-Chief

HANDBOOK OF PSYCHOLOGY

HANDBOOK OF PSYCHOLOGY

VOLUME 7: EDUCATIONAL PSYCHOLOGY

Second Edition

Volume Editors

WILLIAM M. REYNOLDS AND GLORIA E. MILLER

Editor-in-Chief

IRVING B. WEINER

WILEY

John Wiley & Sons, Inc.

This book is printed on acid-free paper. ♾

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

For general information on our other products and services please contact our Customer Care Department within the U.S. at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books. For more information about Wiley products, visit our website at www.wiley.com.

Library of Congress Cataloging-in-Publication Data:
Handbook of psychology / Irving B. Weiner, editor-in-chief. — 2nd ed.
v. cm.
Includes bibliographical references and index.
ISBN 978-0-470-61904-9 (set) – ISBN 978-0-470-64777-6 (cloth : v. 7); ISBN 978-1-118-28193-2 (ebk); ISBN 978-1-118-28260-1 (ebk); ISBN 978-1-118-28534-3 (ebk)
1. Psychology. I. Weiner, Irving B.
BF121.H213 2013
150—dc23
2012005833

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1

To our parents,
Hugo and Martha Reynolds
and
Joseph and Victoria Miller,

to our former and current Teachers, Students, and Colleagues,
who have continued to fuel and inspire our desire for life-long learning,

and to the memory of our friend Mike Pressley
who made a significant impact on our lives and the field of Educational Psychology.

William M. Reynolds, PhD
Department of Psychology
Humboldt State University
&
Gloria E. Miller, PhD
College of Education
University of Denver

Editorial Board

Contents

Handbook of Psychology Preface

The first edition of the 12-volume *Handbook of Psychology* was published in 2003 to provide a comprehensive overview of the current status and anticipated future directions of basic and applied psychology and to serve as a reference source and textbook for the ensuing decade. With 10 years having elapsed, and psychological knowledge and applications continuing to expand, the time has come for this second edition to appear. In addition to well-referenced updating of the first edition content, this second edition of the *Handbook* reflects the fresh perspectives of some new volume editors, chapter authors, and subject areas. However, the conceptualization and organization of the *Handbook*, as stated next, remain the same.

Psychologists commonly regard their discipline as the science of behavior, and the pursuits of behavioral scientists range from the natural sciences to the social sciences and embrace a wide variety of objects of investigation. Some psychologists have more in common with biologists than with most other psychologists, and some have more in common with sociologists than with most of their psychological colleagues. Some psychologists are interested primarily in the behavior of animals, some in the behavior of people, and others in the behavior of organizations. These and other dimensions of difference among psychological scientists are matched by equal if not greater heterogeneity among psychological practitioners, who apply a vast array of methods in many different settings to achieve highly varied purposes. This 12-volume *Handbook of Psychology* captures the breadth and diversity of psychology and encompasses interests and concerns shared by psychologists in all branches of the field. To this end, leading national and international scholars and practitioners have collaborated to produce 301 authoritative and detailed chapters covering all fundamental facets of the discipline.

Two unifying threads run through the science of behavior. The first is a common history rooted in conceptual and empirical approaches to understanding the nature of behavior. The specific histories of all specialty areas in psychology trace their origins to the formulations of the classical philosophers and the early experimentalists, and appreciation for the historical evolution of psychology in all of its variations transcends identifying oneself as a particular kind of psychologist. Accordingly, Volume 1 in the *Handbook*, again edited by Donald Freedheim, is devoted to the *History of Psychology* as it emerged in many areas of scientific study and applied technology.

A second unifying thread in psychology is a commitment to the development and utilization of research methods suitable for collecting and analyzing behavioral data. With attention both to specific procedures and to their application in particular settings, Volume 2, again edited by John Schinka and Wayne Velicer, addresses *Research Methods in Psychology*.

Volumes 3 through 7 of the *Handbook* present the substantive content of psychological knowledge in five areas of study. Volume 3, which addressed *Biological Psychology* in the first edition, has in light of developments in the field been retitled in the second edition to cover *Behavioral Neuroscience*. Randy Nelson continues as editor of this volume and is joined by Sheri Mizumori as a new co-editor. Volume 4 concerns *Experimental Psychology* and is again edited by Alice Healy and Robert Proctor. Volume 5 on *Personality and Social Psychology* has been reorganized by two new co-editors, Howard Tennen and Jerry Suls. Volume 6 on *Developmental Psychology* is again edited by Richard Lerner, Ann Easterbrooks, and Jayanthi Mistry. William Reynolds and Gloria Miller continue as co-editors of Volume 7 on *Educational Psychology*.

Volumes 8 through 12 address the application of psychological knowledge in five broad areas of professional practice. Thomas Widiger and George Stricker continue as co-editors of Volume 8 on *Clinical Psychology*. Volume 9 on *Health Psychology* is again co-edited by Arthur Nezu, Christine Nezu, and Pamela Geller. Continuing to co-edit Volume 10 on *Assessment Psychology* are John Graham and Jack Naglieri. Randy Otto joins the Editorial Board as the new editor of Volume 11 on *Forensic Psychology*. Also joining the Editorial Board are two new co-editors, Neal Schmitt and Scott Highhouse, who have reorganized Volume 12 on *Industrial and Organizational Psychology*.

The *Handbook of Psychology* was prepared to educate and inform readers about the present state of psychological knowledge and about anticipated advances in behavioral science research and practice. To this end, the *Handbook* volumes address the needs and interests of three groups. First, for graduate students in behavioral science, the volumes provide advanced instruction in the basic concepts and methods that define the fields they cover, together with a review of current knowledge, core literature, and likely future directions. Second, in addition to serving as graduate textbooks, the volumes offer professional psychologists an opportunity to read and contemplate the views of distinguished colleagues concerning the central thrusts of research and the leading edges of practice in their respective fields. Third, for psychologists seeking to become conversant with fields outside their own specialty and for persons outside of psychology seeking information about psychological matters, the *Handbook* volumes serve as a reference source for expanding their knowledge and directing them to additional sources in the literature.

The preparation of this *Handbook* was made possible by the diligence and scholarly sophistication of 24 volume editors and co-editors who constituted the Editorial Board. As Editor-in-Chief, I want to thank each of these colleagues for the pleasure of their collaboration in this project. I compliment them for having recruited an outstanding cast of contributors to their volumes and then working closely with these authors to achieve chapters that will stand each in their own right as valuable contributions to the literature. Finally, I would like to thank Brittany White for her exemplary work as my administrator for our manuscript management system, and the editorial staff of John Wiley & Sons for encouraging and helping bring to fruition this second edition of the *Handbook*, particularly Patricia Rossi, Executive Editor, and Kara Borbely, Editorial Program Coordinator.

Irving B. Weiner
Tampa, Florida

Volume Preface

SCOPE AND SIGNIFICANCE OF THIS VOLUME

This volume of the *Handbook of Psychology* is dedicated to the broad and important field of educational psychology. Educational psychology, in large part, is focused on the application of psychological principles and methodologies to the study of human learning and development in educational settings. Educational psychology traces its roots to the beginnings of psychology as a field of study in the United States with the pioneering work of William James. Research in the field of educational psychology has progressed over the past 100 years with an explosion of research across numerous domains of this field in the last quarter of the 20th century and first decade of the 21st century.

A careful reading of this volume will show that researchers in educational psychology are actively engaged in studying the complexity of learning and learner characteristics across multiple systems, sociocultural settings, and novel learning environments. We suggest that, more than any other area of psychology, the field of educational psychology has had a major impact in helping to prepare children for living in an increasingly diverse, global world of rapid change. Educational psychologists over the past two decades have contributed to a burgeoning literature on individual and internal cognitive processes related to learning. Along with our greater knowledge of cognitive processes and learner characteristics has come a concomitant increase in our understanding of the roles played by culture, ethnicity, and gender and how learning is affected by the social context of the classroom. This has led to an improved science of instruction, assessment, evaluation, and how we train our teachers, and a more comprehensive view of the complex roles of teachers, the instructional process, and factors across home, school, and technological environments that lead to behavioral, academic, and social success of an ever more diverse population of students.

The chapter topics selected for inclusion in this volume reflect the field's unique concern for and methods of studying human learning and development in educational settings. The structure and organization of this book provide a window on the current thinking about individual learners, instructional strategies, the dynamics of classroom interaction, social structures that operate in educational settings, and psychology as applied to children in school with diverse needs. We have included chapters that provide a glimpse of how the field of educational psychology has and will continue to impact reforms in teacher preparation, educational research, and policy. The major sections of this volume cover significant cognitive contributions to learning, development, and instruction; what we know about sociocultural, instructional, and relational processes critical to successful learning; early education and the design of effective curriculum applications; psychology applied to students with special needs; and educational research and methodologies that will influence educational reform in the future.

The chapters in this volume include many of the core domains of research that have and are currently fostering major advances in the knowledge base and the basic and applied endeavors in the field of educational psychology. Several conscious editorial decisions were made to shape the scope of this volume so as to minimize overlap with other volumes in the *Handbook*. First, although prior handbooks in the field of educational psychology have provided one or more chapters on the historical precedents that have shaped the field, such a chapter was omitted here because much of this content was included in Volume 1 of the *Handbook*, entitled *History of Psychology*. Similarly, although educational research and assessment chapters are typically included more comprehensively within handbooks representing the field of educational psychology, only one chapter was included here because these topics are extensively covered in two other *Handbook* volumes: Volume 2, *Research Methods in Psychology*, and Volume 10, *Assessment Psychology*, respectively. Finally, developmental issues, especially as they relate to issues of individual learning, interpersonal relationships, and schooling, are embedded within and across many of the chapters included in this volume. This helped to lessen the overlap with coverage of normal development topics that are the focus of Volume 6, *Developmental Psychology*. Limited coverage was also given to areas associated with child and adolescent psychological disorders and mental health and to wellness and prevention issues pertinent to creating safe and healthy school and community environments. These topics are covered in Volume 8, *Clinical Psychology*, and in Volume 9, *Health Psychology*, respectively.

The field of educational psychology has a rich heritage. As the chapters in this book attest, the field has shown near-exponential growth in the examination of complex learning, cognitive, instructional, character, sociocultural, motivational, and individual differences and learner characteristics. The sum total of this research contribution to the understanding of learners and the instructional and learning process represents an important application of psychology to education and the needs of the learner.

The chapters in this book illustrate the dynamic nature of educational psychology as a field of scientific inquiry within psychology. Although we often conceptualize educational psychology as an applied field of study, what can be more basic than understanding the process by which we learn? This book examines what we know about learners in classroom settings; their cognitions, behaviors, and interactions with teachers and peers in the context of learning; learner characteristics, systems of motivation, and self-regulation; and other variables that inform us as to the interactions that are part of the learning process in an ever more complex society.

OUR INTERESTS IN THE FIELD OF EDUCATIONAL PSYCHOLOGY, AND ACKNOWLEDGMENTS

WMR

My interest in educational psychology dates back to my undergraduate days in the early 1970s at the University of California at Berkeley, where faculty members such as Read Tuddenham, Arthur Jensen, and Marjorie Honzik stimulated my interest in the study of intelligence, cognitive assessment, and individual differences. Although I started out in chemistry and worked as a lab assistant at Berkeley for three years, my interest in children with cognitive, social, and emotional needs led me to Tolman Hall and psychology as a major. During this time I was active as a volunteer and later student director of the Richmond Project, a UC Berkeley student organization in which students worked as volunteer aides in the Richmond, California, public schools. For nearly 2 years I spent 1 or 2 days a week at Cortez School, an inner-city school where Mrs. Mary Carbone, a progressive third-grade teacher, allowed me to work in small groups with children and apply what I was learning in my psychology courses to the elementary school classroom. This interest in the field continued as a graduate student in the Department of Educational Psychology at the University of Oregon, where Dr. Richard Rankin provided guidance in understanding the psychometric foundations underlying the evaluation of intelligence and the application of scientific methods to the study of individual differences, and encouraged my teaching the graduate course Mental Testing. This experience, along with mentoring and coursework in clinical psychology provided by Dr. Norm Sundberg, coursework in test construction with Dr. Lew Goldberg, and collaboration in test construction with Drs. Paul Raffeld and Larry Irvin, triggered a switch in graduate school goals from a career as a school psychologist to that of a university professor.

My subsequent employment in the field of educational psychology occurred over nearly a quarter of a century as a faculty member in departments of educational psychology at the State University of New York at Albany (1976 to 1980), the University of Wisconsin–Madison (1980 to 1991) (where 30 years ago I was pleased to serve on the dissertation committee of my esteemed coeditor), and the University of British Columbia (1991 to 2000). Since then I have continued my university employment in a department of psychology, with a substantial focus on training students in school psychology.

I wish to acknowledge the influence and example provided by my colleagues and friends in the Department of Educational Psychology at the University of Wisconsin–Madison during my years of teaching there. The intellectual stimulation and positive interactions provided by my colleagues and the graduate students in the educational psychology department at UW–Madison were a wonderful unlisted job benefit. I am exceptionally pleased that a number of these colleagues and good friends—Maribeth Gettinger, Joel Levin, Tom Kratochwill, Rich Lehrer, Chris McCormick, and Dan Lapsley—have contributed directly to this volume. I am also pleased that Ricki Goldman, my colleague from the University of British Columbia, also contributed a chapter for this volume.

I especially wish to thank my coeditor and coauthor, Gloria Miller, my colleague of over 30 years, for her excellent work on this volume and her friendship these many years. From the days 30 years ago when Gloria was a graduate student in my courses at Wisconsin to her leadership in multiple fields of educational and school psychology, it has been refreshing and encouraging to see that her energy and positive nature have not declined, nor has her dedication to her friends. Although there is an order to the editorship of this volume on the title page, equal editorship should be understood.

GEM

I began my undergraduate program in the early 1970s as a biology major but very quickly became enthralled by the field of psychology after my first introductory class. I can still recall my fascination and the intellectual stimulation that accompanied my learning about the exciting new advances in learning, cognition, and behavioral neuroscience that were still in their infancy. My dissecting skills as a biology major led to an invitation to become a psychology rat lab assistant. I worked with an older professor who, while trained in Skinnerian conditioning techniques, was more interested in neuroanatomy, brain chemistry, and the effects of environmental learning conditions on brain functioning. The field of medicine and neuropsychology appeared to be my niche—until I took my first of many summer jobs working as a counselor at a camp for children with Down syndrome and other forms of mental retardation. From then on, my interests leaned further away from basic neuroanatomy and more toward applied research in cognition. After three years of teaching reading to students with severe learning disabilities, my interest in learning and development drew me to reexamine the different graduate program opportunities within psychology. How happy I was to discover that in fact there actually was a domain of study called educational psychology that was so closely aligned to my applied instructional research interests.

I had the great fortune of entering the field of educational psychology at a most dynamic and opportune time. The earlier passage of the federal law, PL 99-142, which guaranteed free and appropriate education to all students with disabilities, ensured that funding for educational research was at an all-time high in the late 1970s. As a graduate student at the University of Wisconsin, I worked closely with some of the top educational researchers of the time on several nationally funded projects housed at the Wisconsin Educational Research Center. Through the excellent research mentorship of professors Joel Levin and Steve Yussen, I developed a strong empirical and theoretical foundation in human learning and development, which contributed to my eventual switch into the closely related field of school psychology. There I met and worked collaboratively with my esteemed coauthor, who taught me the intricacies of purposeful and valid assessment that can inform intervention, and Dr. Maribeth Gettinger, who was an exceptional role model of an applied researcher interested in improving academic, behavioral, and social outcomes for all students.

I would not be where I am today without the total support and affection of my deceased parents, Joseph and Victoria Miller, who instilled confidence that I could achieve all of my dreams for the future. My life also has been blessed by my spouse of over 30 years. Thank you, Joseph—you have added depth and breadth to each and every day and have taught me so much about the meaning of love and caring for others without regard for self. I also want to thank my daughter, Erica, for the many loving life lessons we have shared and especially for understanding and accepting the many long evenings and weekends when Mom was back at work—yet again. I am sorry to have missed some of the daily ups and downs that have contributed to your unique development. I am so proud of the wonderful young lady you have become. It is my sincere hope that the work highlighted here will touch your life and future lives of others in many as-yet-unforeseen ways.

Although it is not possible due to space limitations to thank everyone who has contributed significantly to my learning and development over the years, if I could, my list would include many of my K–12 teachers and dynamic university instructors, my school peers, and the students and families with whom I have worked—who have been skillful mentors, patient collaborators, and steady influences during my quest to apply educational psychology theory to improve life outcomes for students, families, and teachers. I also would like to acknowledge the input of my graduate students over the years, who continue to provide inspiration for my teaching and research. Finally, a special thank-you goes to my colleague and coeditor, William (Bill) Reynolds, who honored me yet again with the invitation to collaborate on this exceptional project.

WMR and GEM

It is an honor and a pleasure for us to acknowledge the significant and meaningful contributions of the authors of chapters in this book. Through their own busy schedules, family and personal illnesses, requests for revisions, and other unforeseen events that impacted our lives, the contributors have been wonderful to work with and magnanimous in their time, effort, and scholarship in creating this book. Their work is a reflection of the best in the field and will be instrumental in establishing the important role of educational psychologists in this century. To our chapter authors, you have our most sincere thanks and appreciation. We also wish to note the absence of two authors from the first edition who have passed away, both of whom were major researchers and leaders in the field of educational psychology. Dr. Paul R. Pintrich, a leading figure in the field of motivation research and theory, passed away, leaving a substantial void in his absence. We are especially saddened by the loss of Dr. G. Michael Pressley (Mike), who was a dear personal friend of ours for over 30 years and whose passing was hard felt on a personal level. Mike contributed two chapters to the first edition of this volume, and was one of those iconic figures whose knowledge of who was in the field of educational psychology and what was going on in the field astounded most persons who had the good fortune to meet or know him.

A most important acknowledgment and note of appreciation go to Dr. Irving Weiner, the Editor-in-Chief of the *Handbook of Psychology*. The completion of this enormous undertaking was facilitated greatly by Irv's exceptional editorial leadership. We have never before experienced the level of support, continued guidance, effort, and organization that has been presented by Irv toward the realization of this *Handbook*. We also wish to thank the staff at John Wiley & Sons, as well as Brittany White for their great support and assistance that helped to make this book possible.

William M. Reynolds

Gloria E. Miller

Contributors

Eric M. Anderman, PhD
College of Education and Human Ecology
Ohio State University
Columbus, OH

John Black, PhD
Department of Human Development
Columbia University
New York, NY

Erin Brodhagen
Department of Educational Psychology
University of Wisconsin–Madison
Madison, WI

Michelyn Butler
Department of Educational Psychology
University of Wisconsin–Madison
Madison, WI

Gina Cervetti, PhD
School of Education
University of Michigan
Ann Arbor, MI

Yujin Chang
College of Education and Human Ecology
Ohio State University
Columbus, OH

Ching-I Chen, PhD
Center on Human Development, College of Education
University of Oregon
Eugene, OR

Carey Dimmitt, PhD
School of Education
University of Massachusetts Amherst
Amherst, MA

Maribeth Gettinger, PhD
Department of Educational Psychology
University of Wisconsin–Madison
Madison, WI

Ricki Goldman, PhD
Department of Administration
Leadership and Technology
New York University
New York, NY

DeLeon L. Gray
College of Education and
Human Ecology
Ohio State University
Columbus, OH

Frank M. Gresham, PhD
Department of Psychology
Louisiana State University
Baton Rouge, LA

Vera John-Steiner, PhD
Department of Language, Literacy
& Sociocultural Studies
University of New Mexico
Albuquerque, NM

Mark J. Keitges, PhD
Department of Educational Policy,
Organization, and Leadership
University of Illinois
Champaign, IL

Thomas R. Kratochwill, PhD
Department of Educational Psychology
University of Wisconsin–Madison
Madison, WI

Daniel K. Lapsley, PhD
Department of Psychology
University of Notre Dame
Notre Dame, IN

Richard Lehrer, PhD
Department of Teaching and Learning,
George Peabody College
Vanderbilt University
Nashville, TN

Richard Lesh, PhD
Department of Learning Sciences
Indiana University
Bloomington, IN

Joel R. Levin, PhD
Department of Educational Psychology
University of Arizona
Tucson, AZ

Holbrook Mahn, PhD
Department of Language, Literacy
& Sociocultural Studies
University of New Mexico
Albuquerque, NM

John W. Maxwell, PhD
Canadian Centre for Studies in Publishing
Simon Fraser University
Burnaby, BC Canada

Barbara L. McCombs, PhD
Applied Research and Technology Institute
University of Denver
Denver, CO

Christine B. McCormick, PhD
School of Education
University of Massachusetts Amherst
Amherst, MA

Gloria E. Miller, PhD
Morgridge College of Education
University of Denver
Denver, CO

Paula Olszewski-Kubilius, PhD
Department of Education and Social Policy
Northwestern University
Evanston, IL

P. David Pearson, PhD
Graduate School of Education
University of California, Berkeley
Berkeley, CA

Robert C. Pianta, PhD
Curry School of Education
University of Virginia
Charlottesville, VA

Jan L. Plass, PhD
Department of Administration
Leadership and Technology
New York University
New York, NY

Maria Pomés, PhD
Center on Human Development,
College of Education
University of Oregon
Eugene, OR

Lois Pribble, PhD
Center on Human Development,
College of Education
University of Oregon
Eugene, OR

William M. Reynolds, PhD
Department of Psychology
Humboldt State University
Arcata, CA

Terri J. Sabol, PhD
Center for Advanced Study
of Teaching and Learning
University of Virginia
Charlottesville, VA

Clarissa Schienebeck
Department of Educational Psychology
University of Wisconsin–Madison
Madison, WI

Dale H. Schunk, PhD
School of Education
University of North Carolina
Greensboro, NC

Robert E. Slavin, PhD
Center for Research on Education
of Students Placed at Risk
Johns Hopkins University
Baltimore, MD

Jane Squires, PhD
Center on Human Development,
College of Education
University of Oregon
Eugene, OR

Robert J. Sternberg, PhD
Provost Office
Oklahoma State University
Stillwater, OK

Florence R. Sullivan, PhD
School of Education
University of Massachusetts Amherst
Amherst, MA

Dana Thomson, PhD
Department of Education and Social Policy
Northwestern University
Evanston, IL

Hill M. Walker, PhD
College of Education
University of Oregon
Eugene, OR

Kathryn R. Wentzel, PhD
Department of Human Development
University of Maryland
College Park, MD

Jennifer A. Whitcomb, PhD
School of Education
University of Colorado at Boulder
Boulder, CO

David Yeager, PhD
Department of Psychology
University of Texas
Austin, TX

Barry J. Zimmerman, PhD
Department of Psychology
City University of New York
New York, NY

CHAPTER 1

Educational Psychology: Contemporary Perspectives

WILLIAM M. REYNOLDS AND GLORIA E. MILLER

INTRODUCTION TO EDUCATIONAL PSYCHOLOGY

The field of educational psychology traces its beginnings to some of the major figures in psychology at the turn of the past century. William James at Harvard University, who is often associated with the founding of psychology in the United States, in the late 1800s published influential books on psychology (1890) and educational psychology (1899). Other major theorists and thinkers that figure in the early history of the field include G. Stanley Hall, John Dewey, and Edward L. Thorndike. Hall, cofounder of the American Psychological Association and its first president was a student of James. Dewey (1916), who at the University of Chicago introduced major educational reforms in the United States, was one of Hall's students. Thorndike, who we often associate with theories of intelligence and learning, was also one of James's students. He published the book *Educational Psychology* (Thorndike, 1903) early in his career and went on to start the *Journal of Educational Psychology* in 1910, one of the first journals to be published by the American Psychological Association. Thorndike had a tremendous influence on the study of psychology in the early 1900s, and in the integration of learning theory, individual differences, and psychometric methods into educational and school-based research (Beatty, 1998). Similarly, the impact of Lewis Terman (Terman & Childs, 1912) on the field of educational psychology and the assessment of intelligence and the study of gifted children (as well as related areas such as educational tracking), was monumental at this time and throughout much of the 20th century. Others, such as Huey (1900, 1901, 1908) were conducting groundbreaking psychological research to advance the understanding of important educational fields such as reading and writing. Further influences on educational psychology, and its impact on the field of education, have been linked to European philosophers of the mid- and late 19th century. For example, the impact of Herbart on educational reforms and teacher preparation in the United States has been described by Hilgard (1996) in his history of educational psychology. Largely ignored by western psychologists until the 1980s, the work of Russian psychologists in the early 20th century, and in particular the work of Lev Vygotsky (1926/1997, 1978) also contributed to the field of educational psychology. As readers of this volume will find, the work and influence of Vygotsky permeates research in educational psychology in the United States at the end of the 20th and into the 21st century.

This volume of the *Handbook of Psychology* does not delve into the historical foundations of educational psychology but rather deals with exemplar research and practice domains of educational psychology in the latter part of the 20th and early 21st century, with a focus on promising research and trends. Historical antecedents of this field of psychology are presented in Volume 1 of the *Handbook*.

It is evident from the chapters in this volume that much of the research in educational psychology has been conducted in classroom settings, which mirror the applied nature of this field. This research encompasses a broad range of related topics including: children's learning and abilities, reading, classroom processes, and teacher effectiveness. Educational psychology has been described as a discipline uniquely focused upon "the systematic study of the individual in context" (Berliner & Calfee, 1996, p. 6). The long-term focus on the study of children in classroom situations assists in the direct translation of research to practice. This is not a new idea, and has been the driving force of this field for more than 100 years.

From a pedagogical perspective, educational psychology differs from most fields of psychology in that it is often found as a separate department in universities and colleges. To some extent this reflects the diversity of research and academic domains within educational psychology, as well as the rich and applied nature of this field of study. Departments of educational psychology are most often found in colleges of education, and courses in educational psychology are typically required for students in teacher education programs and related majors.

The field of educational psychology has ties to many professional organizations and professional societies in the United States and other countries. In the United States, the two major organizations that represent the field of educational psychology are the American Psychological Association (APA) and the American Educational Research Association (AERA). In the APA, educational psychology has as its primary affiliation, Division 15, Educational Psychology, with secondary affiliations in Divisions 5 (Measurement & Statistics), 7 (Developmental Psychology), and 16 (School Psychology). In the AERA, Division C (Learning and Instruction) largely represents educational psychology with additional representation in Division D (Measurement & Research Methodology), Division E (Counseling and Human Development), and Division H (School Evaluation and Program Development). We also note that a number of prominent educational psychologists, including Lee Cronbach and Frank Farley have served as president of both APA and AERA, with Cronbach also serving as president of the Psychometric Society, and Farley president of numerous APA divisions and other professional organizations. A number of other professional organizations that have substantial overlap with educational psychology include the International Reading Association, Council for Exceptional Children, National Association of School Psychologists, Psychometric Society, Society for Research in Child Development, Society for Research on Adolescence, and other societies and associations.

Contemporary educational psychology encompasses a broad and complex array of topics, research, and social policies. Research in educational psychology is often designed to provide insights into authentic educational problems, using empirical, rather than normative or subjective judgments. It is important to recognize that qualitative methodologies also provide empirical bases for understanding educational problems (Levin & Kratochwill, this volume). The field of educational psychology, possibly more than any other, has been shaped by many multidisciplinary factors. The impact of the cognitive revolution, for example, has been broadened by incorporation of other subdisciplines, including sociology, linguistics, neuroscience, philosophy, and the associated fields of psychology. The major focus of educational psychology, however, is on individuals and their development especially within educational settings. Another important characteristic of the field of educational psychology is that issues of concern are not mutually exclusive and in fact tend to overlap and interrelate more than stand as isolated domains of knowledge. More recently the field has included in its focus the study of new technology-based and computerized learning environments (Graesser, 2009), the depth of which is illustrated by Goldman, Black, Maxwell, Plass, and Keitges (this volume).

Educational psychology includes a rich heritage in the domains of research design and methodology, including statistics and measurement. For most of the 20th century, educational psychologists have contributed to enhancing statistical and measurement procedures, and this continues into the 21st century. As an example, in the 1950s two educational psychologists published papers reporting on statistical and measurement procedures that have become among the most frequently cited articles in psychology. Cronbach's (1951) classic paper on the internal structure of tests and the derivation of coefficient alpha as an internal measurement of reliability continues to be one of the most cited papers in the behavioral sciences and the most used (and also debated) procedure for the measurement of test reliability. Henry Kaiser's dissertation in educational psychology at the University of California at Berkeley in the mid-1950s provided the basis for an orthogonal rotation procedure in factor analysis that he called varimax factor rotation (1958), with various little jiffy procedures to follow. Donald Campbell (an APA president) and educational psychologist Julian Stanley (an AERA president), published a little volume in 1966 (expanding on the great work of Iowa educational psychologist E. F. Lindquist

[1940] who was also cofounder of the American College Testing Program—ACT), which provided a simple structure for researchers in many fields for understanding basic research designs and associated threats to internal and external validity. This work also laid the foundation for the development of numerous quasi-experimental designs (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002) that are critical to educational research and program evaluation. These are but a few of the many statistical, measurement, and methodological contributions that have been and continue to be made to the field of psychology, and behavioral and social sciences by educational psychologists.

CURRENT PRESENTATIONS OF THE FIELD

A comprehensive review of major work across the field of educational psychology was presented in the publication the *Handbook of Educational Psychology*, edited by Berliner and Calfee in 1996. This influential handbook, sponsored by the APA division of Educational Psychology (Division 15), was commissioned to reflect the current state of the field up until the early 1990s. Berliner and Calfee provided a powerful synthesis of the scholarship that defined the scope and relevancy of educational psychology as a discipline up until this time. The major goals of this volume were to offer a vigorous defense of educational psychology as a discipline and to forward the distinctive viewpoints that educational psychologists maintain when explaining educational events. Chapters were organized to represent the major domains within the discipline. Authors were asked to discuss how coverage of these topics changed from 1970 to 1990 and to summarize significant changes in research design within the discipline. The following domains were covered: learning and transfer, motivation, physical and psychological development, intelligence, exceptionality, psychology of learning within subject matters, assessment, processes of teacher growth and development, the psychology underlying instructional strategies, educational technology, and the methodological, philosophical, and historical foundations of the field.

Several consistent conceptual threads ran through the majority of invited chapters. One was the critical paradigm shift from behaviorism to cognitive psychology that shaped the discipline over this period. Another commonality across topics was that this conceptual shift resulted in a vigorous debate regarding research methods. What has emerged is a greater range of analytical tools, a methodological pluralism marked by some promising new practices such as exploratory data analysis (Jaeger & Bond, 1996) and design experiments (Brown, 1992). In drawing conclusions about the field, Berliner and Calfee suggested that the discipline's bread and butter issues had not changed as dramatically as the conceptual and methodological tools that educational psychologists employ to understand educational phenomena. They also concluded on a note of congratulatory celebration at what educational psychology, as a discipline, has contributed and looked optimistically to its future.

Although not yet published as the current volume was going into production, the American Psychological Association has undertaken a three-volume, 1,800-plus page work covering the many domains within educational psychology (Harris, Graham, & Urdan, in press). Volumes of this work focus on the diversity of theories, constructs, and issues in educational psychology; the study of individual differences and the contextual and cultural influences on persons; and how the field of educational psychology informs and advances our understanding of learning and teaching.

Pressley and Roehrig (2002) provided a synopsis of the major domains reflected in the field of Educational Psychology during the past 40 years of the 20th century. These researchers categorized all research articles published in the 1960–1961 and the 1997–1998 issues of the *Journal of Educational Psychology*, the leading journal serving the field. Domains of information reflected in three contemporary handbooks, texts were also categorized, and editorial board members of the *Journal of Educational Psychology* were surveyed for their opinions of texts and articles that had the most significant impact on the field. The consensus of these reviews is amazingly similar in that at least 11 consistent domains appear: cognition; learning; development; motivation; individual differences; teaching and instruction; classroom and sociocultural processes; social relations in education; psychological foundations of curriculum; educational technology; and educational research methods and assessment.

These authors also noted that behaviorism and then the cognitive revolution were two critical forces driving the field, with the former more prevalent before the 1960s and the latter dominating the past 40 years (Pressley & Roehrig, 2002). Many significant changes were noted that led up to this change, beginning with the idea that an internal processing system and internal mechanisms could be objectified and studied (Miller, Galanter, & Pribram, 1960, *Plans and the Structure of Behavior*) and followed by work centered on memory (Tulving & Donaldson, 1972), imagery (Levin, 1973; Paivio, 1971) and other learning processes (Rohwer, 1970; Schank & Abelson, 1977).

Instructional theory and innovations were impacted by Bruner's writings (1960, 1966), as well as the work of Hunt (1961) and Flavell (1963), who together with others (Brainerd, 1978; Inhelder, Sinclair, & Bovet, 1974) helped introduce and transform Piaget's ideas into work on children's thinking. Other's work was more directly linked to educational application, especially in regards to observational and social learning, (Bandura, 1969; Rosenthal & Zimmerman, 1978), text comprehension (Anderson & Pearson, 1984; Kintsch, 1989), writing (Flower & Hayes, 1980), problem-solving and mathematics (Mayer, 1976; Polya, 1957; Schoenfeld, 1985).

Sociocultural and cross-cultural contexts were introduced as important factors influencing learning and cognition. Schooling and other critical contexts have been more prominent in the field since the pioneering work of Scribner and Cole in the 1980s and the influence of Vygotsky's work with the 1978 translation of *Mind and Society*. This work has helped to reconceptualize instruction and teacher training, as well as related domains of cognitive psychology. It has moved the field from an individual focus to a broader interpersonal framework. Much of the current research reflects the idea that the child, adults and the contexts surrounding an event are responsible for forwarding cognitive activity and building competence. These ideas have been inspired by Vygotskian theory and have contributed to substantial reforms reshaping contemporary school environments. They have had a direct impact on the design of instruction and have had a profound influence on educational research innovation. The linkages between theory and teacher learning, teacher and student relations and the social climate in classrooms have all become more significant domains of study within the field of educational psychology. We find it of interest to note the extensive citations to the work of Vygotsky across many of the chapters in this volume.

Theories of motivation and its effect on cognition, learning, and social relations have also been more prominent. Historically, the work in educational psychology was dominated by an emphasis on cognition and motivation was ignored. Recent work has pointed to the importance of motivational constructs that apply to all individuals and that can explain important individual differences in cognition. The seminal work of Bernard Weiner (1979) has been instrumental in promoting research that linked cognition and motivation. Ames in the early 1980s also helped connect goal theory with classroom performance (Ames, 1984; Ames & Archer, 1988), others have looked at classroom structures that make a difference in student performance and have refocused on educational motivation as a cognitive enterprise.

Over the past two decades, education and educational issues have dominated both state and national agendas (e.g., No Child Left Behind). It is no surprise that educational psychologists have been involved in or have directed many of these studies that have become a major force in crafting federal policies and legislation. For example, in the 1990s, a group of psychologists who were members of the Division of Educational Psychology (Division 15) of the American Psychological Association were instrumental in producing a collaborative document outlining critical learning principles for all students (*Learning Principles for All Students*, Lambert & McCombs, 1998). Barbara McCombs, one of the original editors of this publication, reviews in this volume the issues addressed in this document and the impact it has had on recent federal educational policy and reforms. The American Psychological Association has in the latter part of the 20th century been instrumental in its professional contribution to educational reforms in this country (e.g., *Learner–Centered Principles: A Framework for School Redesign and Reform*, American Psychological Association Board of Educational Affairs, 1995), with the field of educational psychology providing the foundation for this contribution. Recently, the American Psychological Association in collaboration with the Association of Psychological Sciences produced a listing of 25 cognitive principles of learning adapted to a lifelong learning perspective (Graesser, Halpern, & Hakel, 2008).

DISTINCTIVENESS OF THIS VOLUME

This handbook looks at how the discipline of educational psychology will shape the next generation of learners and teachers. Three immediate contextual factors have begun to influence the evolving role of educational psychology in educational practice. First, the gossamer threads of the Internet, a symbol of the information age, will expand increasingly to reach all sectors of our society, and in particular, education. Learners and teachers in the information age will more than ever need to be flexible, reflective, motivated learners. Second, in the next decade a significant number of individuals will go through formal teacher education and begin careers. How they use the knowledge, concepts, and methods of educational psychology as they engage in essential acts of teaching (Grant & Murray, 1999) will be critical. Third, the policy community will have a powerful impact on the funding of research programs sponsored by both the federal government and foundations.

This volume builds upon the optimistic future that Berliner and Calfee (1996) foreshadowed regarding the discipline of educational psychology. Although their handbook provided a systematic overview of the field of educational psychology and legitimized the relevance of this distinct discipline, this volume seeks to highlight key concepts of ongoing research conducted at the beginning of the 21st century. A second goal of this volume is to identify more exclusively the key promising areas for continued research over the next two decades.

This volume both elaborates on and departs from previous handbook domains. There are distinct overlaps in the following areas of cognition, learning, and motivation, and in reviews of applications of educational psychology to curriculum, classroom, and teaching processes and exceptional learners. We depart, however, in that our intent was to selectively focus on topics that have strongly influenced the field in the new century. We also choose to deemphasize traditional school subject domains and instead selected four areas—early childhood, literacy, mathematics learning, and new technologies. These curriculum areas have not only increasingly taken the forefront both in the quantity of research conducted but also have repeatedly been in the public and policy spotlight influencing many areas of school reform.

Another departure from prior handbooks is that we did not have a separate section or chapters in child and adolescent development or research methodologies because independent volumes in this series are devoted to these topics. (See Volumes 6 and 2.) Instead, many of the authors here reviewed contemporary developmental findings and elaborated on contemporary research methodologies within their respective domains of study. An early emphasis in educational psychology was the study of "character" as an important aspect of the child in school, and one that has re-emerged as a vital domain of research (Lapsley & Yeager, this volume). Thankfully, teachers no longer develop moral character in students by using wooden rulers. We acknowledge the impact of educational psychology on teaching by including chapters on teaching processes and a more contemporary chapter on teacher learning and teacher education and preparation, which again are issues where educational psychology research may have a strong influence on such policy in the future.

OVERVIEW OF THIS VOLUME

The chapters in this volume can be viewed as covering five major domains of contemporary research in educational psychology. *Cognitive and Regulatory Contributions to Learning, Development, and Instruction* chapters focus on processes and factors affecting the learner and learning, including individual differences and contextual influences in intellectual processes, metacognition, self-regulation, and motivation. *Sociocultural, Instruction and Relational Processes* chapters examine sociocultural, moral-character development, school adjustment, and interpersonal and relational processes between teachers and students in culturally situated settings for learning. *Early Education and Curriculum Applications* chapters highlight psychological contributions to improving outcomes in early childhood, the psychology of literacy, mathematics, and new media technologies for learning. The chapters in the domain of *Psychology in the Schools* focus on understanding the school-based and developmental needs of exceptional learners. Finally, chapters in the *Educational Programs, Research, and Policy* section review current practices in teacher preparation, educational and psychological research for evidence-based outcomes, and the pressing need to transform the immense knowledge base established by educational psychology researchers into sound educational policy and reform.

The authors who contributed to this volume were selected not only for their important and long-standing research contributions, but also because their work reflects the most current areas of research defining their respective fields of scientific inquiry in educational psychology. These authors integrate and synthesize research as well as formulate meaningful directions and suggestions for further scientific study. Each of the chapters in this volume provides a unique examination of an important area within educational psychology. The significant communalities across chapters highlight the connectedness and internal consistency of educational psychology as a field of scholarship. These common threads are further expanded upon in the last chapter of this book.

Cognitive and Regulatory Contributions to Learning, Development, and Instruction

The focus of this section is on cognitive processes within the learner and teacher, and includes the development of such processes and developmental directions for future research. Developmental theory is not singled out here, because Volume 6 in this *Handbook of Psychology* series is dedicated exclusively to this topic. Prominent in this work is a focus on individual differences in intellectual processes, metacognition, self-regulation, and motivation. The chapters in this section also exemplify the field of educational psychology by relating theory to instruction and factors affecting individual learners and teachers within classrooms.

Contemporary Theories of Intelligence

The field of educational psychology has a long history of research and interest in the theory and study of intelligence. In the early part of the 20th century, the *Journal of Educational Psychology* was the primary scientific journal in this country for research on the study of intelligence. In addition to theories, a major emphasis in this field of inquiry was its measurement, which continues to occupy a significant place in the study of intelligence. Sternberg (this volume) reviews both classical and contemporary intelligence theories and their profound implications on practical life and societies. He critically evaluates classical intelligence theories that have had a strong impact on education and goes on to present challenges to these and to current conceptions of intelligence. Intelligence-related abilities permeate many areas of society. In the United States and many other Westernized nations, these are most visibly represented in a multitude of educational and occupational tests shown to relate to societal success. Competing views about the sorting influence of intelligence are presented. Sternberg concludes that societies often choose a similar array of criteria to sort people, but he cautions that such correlations may simply be an artifact of societally preferred groups rather than a result of some “invisible hand of nature.”

Sternberg describes the need for psychometrically sound measures of intelligence as a necessary prerequisite for the validation of theories of intelligence. A significant trend in the past two decades has been the development of intelligence tests based on cognitive and information processing theories of intelligence. Literature is presented on implicit views of intelligence that have served as the basis for explicit conceptions and tests of intelligence. The early biological theories of Halstead (1951), Hebb (1949), and Luria (1980) are reviewed and contrasted with more contemporary biological findings and theories that are poised to have a substantial influence on psychometric work in the future.

Self-Regulation and Learning

Schunk and Zimmerman (this volume) discuss the role of self-generated or self-directed activities that students use during learning. These notions strongly suggest that students are actively constructing and exercising control over their learning and social goals. Work in the past two decades has isolated integral components of self-regulation processes that influence achievement cognitions, behaviors, and emotions (Schunk & Zimmerman, 2008). Researchers have continued to demonstrate that successful learning is a result of key self-regulation abilities, such as attending to instruction, setting personal goals, processing of information, rehearsing and relating new learning to prior knowledge, believing that one is capable of learning, and establishing productive social relationships and work environments (Zimmerman & Schunk, 2004).

Five theoretical perspectives are reviewed that have characterized work within this area: operant theory, information processing theory, developmental theory, social constructivist theory, and social cognitive theory. Research to support the role of self-regulatory processes is reviewed as is a well-documented intervention that has been successfully linked to improvements in self-regulation in a variety of learners and across different learning contexts. It is of interest to note that the vast majority of the research presented in this chapter focuses on the examination of psychological constructs within the context of the school classroom. The importance of self-regulation in the learning enterprise is presented and reinforces the critical application of educational psychology toward understanding and how children learn and how we can enhance the learning process.

Metacognition and Learning

McCormick, Dimmitt, and Sullivan (this volume) consider metacognition as a conscious subcomponent of self-regulation that contributes to a learner’s knowledge of and control over cognition and as such demonstrate the refinement that has emerged in the construct since it was first described by Flavell (1976). Research on metacognition is concerned with the knowledge and control of cognitive thought and learning processes that are similar yet distinguished from self-regulation (reviewed by Schunk & Zimmerman, this volume) and executive function. The growth of research in this field can also be recognized by a new journal, *Metacognition and Learning*, devoted exclusively to this domain of knowledge.

Theoretical issues that have driven researchers over the years are presented as well as the current unresolved debates. Research paradigms used to assess such abilities are reviewed, including feeling of knowing, pretest judgments, and judgments after retesting. An argument is made that work in metacognition is best viewed as a bridge between theory and practice. The importance of metacognition to both learner characteristics and curriculum design is highlighted in this chapter. For example, researchers have found that students with general metacognitive skills do better on novel classroom tasks and also are more likely to improve in academic performance over time (Winne & Nesbit, 2010). Classroom environments as well as curriculum adaptations have been designed to encourage metacognitive development (Veenman, Van Hout-Wolters, & Afflerbach, 2006). In a similar manner, metacognitive skills have also been promoted through the use of cooperative or reciprocal peer-learning models. It is useful to note that much of the research in this area has been conducted with authentic academic tasks such as reading, writing, and problem-solving in science and math.

Motivation and Classroom Learning

Motivation is a critical domain of study within the field of educational psychology, with a particular focus on student learning (Pintrich, 2003; Wentzel & Wigfield, 2009). Anderman, Gray, and Chang (this volume) present a comprehensive review of the substantial advances in our scientific knowledge of motivational constructs and their impact on student cognition and learning, especially in classroom settings. Recent developments associated with five major theories of achievement motivation are reviewed. *Self-deterministic* motivational researchers have historically focused on extrinsic and intrinsic motivation and these concepts have been broadened to self-determined versus controlled motivation. *Attribution* motivational researchers consider reasons and explanations of one's success and failure and contemporary research has focused on how teacher feedback and other instructional variables can impact such expectancy beliefs. *Social cognitive* motivational researchers emphasize self-efficacy beliefs, or one's perceived ability to perform a task, and recent work has been conducted to examine how this impacts student learning across critical academic domains such as mathematics (Fast et al., 2010). *Expectancy-value* motivational researchers examine expectations for success and perceptions of task value and recent work within this framework has begun to account for social and cultural factors that predict task performance as well as one's decision to persist and engage in learning (Eccles, 2005). Finally, *achievement-goal* motivational researchers seek to specify situational demands and goal structures most associated with adaptive short- and long-term learning outcomes. This work has expanded beyond simple examinations of mastery versus performance motivation to investigations of performance goal subprocesses, that is, performance-approach where one is preoccupied with demonstrating competence in comparison to others and performance-avoid where the focus is on demonstrating that one is no less competent than others (Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). The chapter ends with a review of research on instructional conditions that affect motivational processes, including how educators make decisions on the selection and presentation of learning tasks, the allocation of rewards, and the assessment of progress and learning outcomes. The general conclusion to be drawn from this large body of work is that many school and classroom structures and instructional processes can be altered successfully to foster the development of important motivational processes (E. Anderman & L. Anderman, 2010; Wentzel & Wigfield, 2007).

Sociocultural, Instructional, and Relational Processes

Contemporary educational psychology draws substantial inspiration and guidance, directly and indirectly, from social learning theory, and in particular from the work of Bandura (1969, 1977, 1982). This work reflects a strong sociocultural perspective in which the emphasis is on interpersonal, motivational, and social processes that occur in classrooms and other culturally situated settings. Likewise, the important contributions of Vygotsky (1926/1997) to educational psychology and the understanding of the learner and the learning environment is as important now as it was more than 80 years ago. Work reviewed here focuses on group structures, cooperative learning, and interpersonal relationships and on the role of personal motivation, goals, and other internalized social processes that contribute to academic, behavioral, and social adaptation.

Vygotsky and Sociocultural Approaches Teaching and Learning

Social and cultural contexts are important considerations for the understanding of learning and development. The influence of Lev Vygotsky in the latter part of the 20th century has provided a scaffold for the development of theories of language acquisition, writing, assessment, concept formation, and other domains of learning. Vygotsky's work and that of other Russian psychologists such as Luria in the early part of the 20th century created a major paradigm shift in western psychology in the 1960s and 1970s (Luria, 1961; Vygotsky, 1962, 1978). This body of work, and in particular the concepts of internal dialog and the verbal mediation of behavior, greatly influenced the field of learning and also the emerging field of cognitive behavior modification, as evidenced in the work of Donald Meichenbaum in the development of self-instructional training (Meichenbaum, 1977).

Mahn and his colleague John-Steiner, one of the original editors of Vygotsky's (1978) major work *Mind in Society: The Development of Higher Psychological Processes*, describe the social and cultural contexts for instruction and learning. Mahn and John-Steiner explore Vygotsky's contributions to educational psychology beginning with an overview of his life's work and the ways in which his theoretical framework has influenced sociocultural approaches to learning and development (Vygotsky, 1978, 1981, 1987, 1993). His growing influence has shaped culturally relevant and dynamic theories of learning.

They discuss sociocultural approaches in educational psychology with an emphasis on the contributions of Vygotsky and his notions of the individual in the creation of contexts and the internalization of person and environment interactions. These broad interdisciplinary applications of Vygotsky's work and theories are presented as Mahn and John-Steiner clarify the philosophical underpinnings of this framework and how it addresses a range of learning outcomes.

The breath of Vygotsky's ideas and their implications for understanding the context and processes of learning are presented, along with the nature of his dialectic method as applied to cognitive processes. The role of Vygotsky's work and theories for educational reform, including children with special needs, assessment and in particular dynamic assessment, and collaborative efforts in education are discussed. Studies that highlight the relationships between context and individual and social processes and underscores the need to develop environments for literacy teaching and learning that honor linguistic and cultural diversity (e.g., Mahn & John-Steiner, 2005) are presented. These authors also review research in two overlapping fields—second language learning and literacy—to discuss the obstacles these learners face when acquiring literacy in a second language with examples of current research.

Moral Character Development

The interest in moral character development, particularly as it plays a role in the education of students predates the field of educational psychology. More recently, there has been a reemergence in the recognition of this field, as shown by a number of professional organizations and journals specific to this domain (Association for Moral Education, the Character Education Partnership, *Journal of Moral Education, Journal of Research in Character Education*). Lapsley and Yeager (this volume) review the assumptions and paradigms in moral character education along with a number of theoretical approaches. The latter including, moral stage theory, domain theory, and moral self-identification. In considering the evidence for moral education, Lapsley and Yeager take a programmatic approach to examine what principles of character education have proven efficacious by researchers and educators.

The authors discuss methods for the implementation of moral character education that involve both traditional implementation strategies (i.e., those relying on explicit persuasion, teaching of skills, or changes in classroom culture and on precise learning objectives, teacher scripts, worksheets, assessments, and professional development workshops) to new *indirect* or "stealthy" intervention strategies (Yeager & Walton, 2011). Indirect or "stealthy" interventions typically assume that (a) children or adolescents at some level know right from wrong and want to do what is right, but (b) critical barriers—such as one's beliefs—restrain their behavior and keep them from acting on their knowledge and motivation. Indirect interventions are designed to remove these barriers using brief changes to the subjective psychological context. They have the advantage of being "small" and minimally invasive, which is useful for promoting internalization, avoiding stigmatization, and preventing deviancy training. Lapsley and Yeager review research supporting the viability of this approach, including use in universal prevention.

Cooperative Learning and Achievement

After reviewing literature conducted over the past 30 years, Slavin (this volume) present an integrative model of the relationships among variables involved in cooperative learning. Slavin moves beyond a review that establishes the effectiveness of cooperative learning to focus more specifically on conditions under which it is optimally effective. Slavin reviews recent empirical work on cooperative learning directed at identifying critical factors that motivate and impede learning outcomes. The work in this area primarily has been framed within four theoretical perspectives: motivational, social cohesion, cognitive-developmental, and cognitive-elaboration. He reviews empirical evidence for each perspective. Critical group processes, teaching practices, or classroom structures are evaluated within each of these frameworks. Although several comparative studies have been conducted to contrast alternative theoretical formats of cooperative learning or to isolate essential elements, this work has been hindered due to the variety of factors examined and the different measures, durations, and subjects that have been used. Slavin offers a theoretical model of cooperative learning processes, which acknowledges the contributions of work from each of the major theoretical perspectives, explores conditions under which each may operate, and suggests research and development needed to advance cooperative learning scholarship.

Research conducted over the past decade has focused on how to structure interactions and incentives among students in cooperative groups. Findings suggest that within cooperative groups a combination of group rewards and strategy training produces much better outcomes than either alone (Slavin, 1995). Several reviews of the cooperative learning literature have concluded that cooperative learning is most consistently effective when groups are recognized or rewarded based on individual learning of their members. Although the specific forms and means of implementing group incentive and individual accountability have varied widely across studies, evidence overwhelmingly points to the need to include both to obtain the greatest, long-standing impact on students' learning.

There is still some controversy about the importance of group goals and individual accountability in providing students with an incentive to help each other and to encourage each other to put forth maximum effort. Studies consistently support the importance of group goals and individual accountability. However, Slavin points out research that demonstrates the times when group goals and individual accountability may not be necessary. For example, when students are working collaboratively on higher level cognitive tasks that lack a single right answer, or where students are already strongly motivated to perform, as in voluntarily formed study groups, or where the tasks are so structured that learning is likely to result simply from participating. Another context where group goals and individual accountability may not be essential is during communal learning groups composed of homogeneous ethnic minority members, possibly because of an already high level of interdependence functioning within African-American communities (Hurley, 1997).

Relationships Between Teachers and Children

The relationship between teachers and their students is complex and multifaceted. Sabol and Pianta (this volume) note that research on teacher processes and teacher-student relationships has moved far beyond its original focus on teachers' and students expectations and instructional interactions, classroom discipline and management, socially mediated learning, school belonging and caring, and teacher support. Many of these topics have roots in basic sources and disciplines within educational and developmental psychology, a sampling of which include the original work of Brophy and Good (1974) on teacher-child interactions, Rosenthal (1969) on classroom interpersonal perceptions and expectations that influence student performance, Vygotsky (1978) on socially constructed development, Bronfenbrenner and Morris (1998) on the influence of multiple contexts on development, Bowlby (1969) and Ainsworth, Blehar, Waters, and Wall (1978) on attachment process between parents and children, and the clinical work investigating marital and familial processes (Bakeman & Gottman, 1986), the role of adult relationships in promoting resiliency (Peterson, Faucher, & Eaton, 1978; Werner & Smith, 1980), and finally the longitudinal contributions of developmental systems theory and longitudinal studies of health and psychopathology (Loeber, 1990; Rutter, 1987).

As conceptualized by Pianta, Hamre, and Stuhlman (2003), child-teacher relationships not only involve the study of verbal and nonverbal communication processes for exchanging information between two individuals, but also embody biologically determined characteristics and attributes of the individuals involved (i.e., age, gender, ethnicity, temperament, developmental history, and experience), individuals' views of the relationship and their own and the other's role in the relationship, and the external systems within which these interactions are embedded. Educational psychologists have been instrumental in demonstrating that such relationships are a central school-based relational resource that has a positive and reciprocal effect on students' learning, achievement, enjoyment, involvement, and school retention as well as on teachers' sense of well-being, efficacy, job satisfaction, and retention in teaching (Pianta, 1999). Sabol and Pianta review the current work on teacher-student relationships that has evolved into a dynamic field of study based on developmental systems theory where relationships are viewed as part of holistic, multilevel interrelated units functioning reciprocally to motivate successful adaptation and developmental change.

Compelling research results suggest that high quality teacher-child relationships protect against known behavioral risk factors. Students with adjustment problems can develop strong relations with teachers, especially when they have a warm, supportive relationship with a preschool or early elementary teacher (e.g., Hamre & Pianta, 2001). This benefit is also corroborated in research on parent-child relationships, with findings that parental warmth stabilizes behavior problems and is associated with a reduction in the growth of externalizing behaviors (e.g., Eisenberg et al., 2005). Positive relationships with teachers provide opportunities to promote the reorganization of relational schema and buffer children from negative developmental outcomes associated with problematic early caregiving experiences (e.g., Zajac & Kobak, 2006). Children from various social, economic, and cultural groups who often demonstrate a higher level of problem outcomes in school also appear to be protected by high-quality relationships with teachers (Hamre & Pianta, 2005). Overall, current research provides substantial evidence for compensatory benefits of positive child-teacher relationships for at-risk children. Studies have begun to uncover how relationships with teachers are related to development, and the extent to which teacher-child relationships may act as a moderator for at-risk children.

School Adjustment

Research has demonstrated that socially adjusted individuals are able to set and achieve personally valued goals that are sanctioned by the larger community as relevant and desirable. Educational psychology researchers have been at the forefront identifying what motivates and mediates such personal goals, the impact of these on personal and school adjustment, and the classroom/school factors that support and promote the expression of these attributes (Wentzel, 2003).

Children's school adjustment and achievement is affected by social competencies, such as social goal pursuit, behavioral skills, and positive interpersonal relationships (Wentzel, 2004). There has been somewhat of a paradigm change in the study of school engagement from how students engage in or refrain from negative behaviors such as aggression, inattention, or class disruption, to the examination of desirable aspects of behavioral engagement such as cooperative, compliant, or self-regulated behavior. These latter behaviors are considered critical for the "social integration" (behaviors that promote the smooth functioning of the social group or that reflect positive social approval) of children and positive developmental outcomes (feelings of personal competence, self-determination, and social and emotional well-being). Researchers also consider competence in children to be best understood in terms of context-specific effectiveness, such as reflected in mastery of culturally and socially defined tasks.

Wentzel (this volume) defines social competence as the extent to which "students accomplish goals that have personal as well as social value in a manner that supports continued psychological and emotional well-being." She highlights the importance of defining school adjustment within an ecological, competence-based framework and the importance of social competencies to overall school adjustment and the interrelationships of social, motivational, and academic success. Wentzel also addresses three important issues in need of consideration and empirical investigation for understanding children's adjustment to school, including: (1) the expectations and goals we hold for our students, (2) the role of developmental processes in choosing these goals, and (3) the development of more sophisticated models, research methods and designs to guide research on school adjustment.

EARLY EDUCATION AND CURRICULUM APPLICATIONS

Educational psychology has always concentrated on the improvement of educational programs and instruction through the application of psychological theories, processes, and research. In this manner, teaching and curriculum materials and technologies are informed by educational psychologists. Work reported in this section centers on the psychological contributions to curriculum and instruction in early childhood, literacy, mathematics, computers, new medias, and technologies for learning. Rather than cover all of the traditional school subject curriculum domains, we selected four broad areas where educational psychologists have had a major and continuing influence over the past two decades. These selected areas have received increasing attention by politicians due to societal pressures and have taken the forefront both in the quantity of research conducted and their influence on key areas of school reform.

Early Childhood Education

According to Squires, Pribble, Chen, and Pomés (this volume), research in early childhood education has grown dramatically over the past two decades in concert with our increased knowledge about the significance of the birth to five period. Squires and her colleagues review work on early childhood education that focuses on creating developmentally appropriate continuums of learning and development for children, supporting a high-quality and well-compensated early childhood workforce, expanding access for children to high-quality programs in all settings, and promoting collaboration among systems serving young children and families. They note there has been more than 50 years of debate regarding the potential benefits of early childhood education. We now know that early childhood education has the potential to support healthy brain growth by providing positive child-caregiver relationships, safe learning environments, and stimulating experiences. Children's brain growth has been shown to be impacted by the quality of their relationships and exposure to consistent, responsive caregiving (National Scientific Council on the Developing Child, 2004, 2007).

Research and practices in early childhood education, as well as beliefs and attitudes about young children are reviewed and tied to theoretical approaches. Because early relationships and experiences are fundamental for building strong brain architecture, early education has a critical role to play. Early education programs can also help bolster the home environment, adding to the stimulating interactions and enriching experiences in a child's life.

There is a body of evidence supporting the positive impact of early childhood programs, which has grown in the past decade. This work began with older studies conducted in the 1960s to 1980s that were focused on figuring out ways to help disadvantaged children obtain better long-term outcomes by random assignment to an early childhood intervention or control group. Results generally indicate that children who attended the preschool program had lower levels of special education placement and higher levels of high school graduation in comparison to children in the control group. As adults, they also had higher income levels, lower levels of welfare assistance and arrest rates, and other positive outcomes. More recent work has been conducted on cost-benefit analyses of high-quality preschool programs. These analyses reveal that such programs have positive economic returns for educational intervention, particularly in comparison to remediation efforts (Reynolds, Temple, White, Ou, & Robertson, 2011; Temple & Reynolds, 2007).

In the past decade, efforts have focused on making sure that educational services are delivered in ways that are effective by identifying evidence-based practices regarding early intervening models (Barnett, VanDerHeyden, & Witt, 2007). Researchers have developed and implemented multitiered models of prevention for young children and have identified critical features of such models (Squires, 2010). These models are designed to help professionals identify young children's needs and services in an effective, timely, and hierarchical approach.

Psychology of Literacy and Literacy Instruction

Perhaps no other single educational issue has received as much national and international attention as literacy development (Pearson, 2007; Pearson & Hiebert, 2010). Pearson and Cervetti (this volume) note the ground breaking work in this area done more than 100 years ago by Huey (1908) who applied psychology to understanding reading and reading instruction. Huey (1900, 1901) was one of the first psychologists to apply scientific methods to the study of reading, examining eye movement and processing speed among other aspects of reading.

Pearson and Cervetti in reviewing this enormous multidimensional domain of literature focus on a number of critical syntheses and reviews by educational psychologists and scholars of reading (Kamil, Pearson, Moje, & Afflerbach, 2011, National Institute of Child & Human Development, 2000; Snowling & Hulme, 2005). They note that various national mandates have emphasized the need for rigorous research in reading, with the No Child Left Behind legislation of 2002 using the term *scientifically based reading research* appearing 110 times in the bill.

Pearson and Cervetti review a multitude of instructional contexts and approaches for reading development that have been studied, with an emphasis on critical reviews of these approaches conducted in the past 20 years. They identify a number of promising lines of research that provide useful information on the various complex processes inherent in learning to read. These range from the construction of mental representation of text and text-level processing, to understanding the issue of volume when examining vocabulary knowledge and literacy development. In addition to these disciplinary approaches, researchers have begun to take more multicomponent approaches across and within various components of the reading processes. For example, Graesser, McNamara, and Kulikovich (2011) have developed an empirically based multidimensional procedure for examining text difficulty in primary and secondary school textbooks. Pearson and Cervetti conclude by noting the complexity of research approaches used for the scientific study of literary and literacy education and how this has led to some tension between scholars in this and other fields such as mathematics education (Schoenfeld & Pearson, 2009).

Mathematics Learning

We often take precursors to the development of mathematics and mathematics learning for granted. The psychology of mathematics learning is a broad field of study. To provide a meaningful discourse on some of the major developments and research in this field, Lehrer and Lesh (this volume) systematically examine the development argument and inscription as these domains relate to mathematics learning. From these basic structures, the authors examine how generalizations evolve in the areas of geometry-measurement and mathematical modeling, the former drawing from the related domain of spatial visualization and the latter an area of needed research in mathematics learning and education. To support their treatise, Lehrer and Lesh utilize cognitive and sociocultural perspectives to examine research and theory in these fields of scientific inquiry.

Lehrer and Lesh formulate and present rationale that describe the development of conversational argument, including such concepts as analogy and the development of relations, conditions, and reasoning and how these provide routes to the formulation of mathematical argument as well as mathematical proof. The role of inscription systems or marks on paper and other media is described as a mediator to mathematics learning. From a developmental perspective, the growth of inscription ability and skills allows for the differentiation of numbers from letters, forms, maps, diagrams, and other aspects of symbolic representation.

Lehrer and Lesh call for a broadened scope in what we consider to be mathematics, taking a cognitive-developmental perspective with particular relevance to classroom-based research and its application to mathematics education. The case is presented for mathematics learning as a complex realm of inquiry that draws from many cognitive domains. Lehrer and Lesh review the research on models and modeling in mathematics education and how this is critical for problem solving in mathematics, particularly at the elementary grade level (Lesh & Harel, in press; Lehrer & Schauble, 2005, 2007). They review significant recent work emphasizing classroom practices that can support productive mathematical thinking even in early elementary classrooms, such as pretend play, setting norms for classroom conversations that emphasize "the need for proof," and the orchestration of guided dialogic experiences generated from collective and shared everyday knowledge.

Learning With Digital Media: Contemporary Theory and Research

Goldman et al. (this volume) present a historical review and creative prospective insights into how technological advances have been shaped and have helped shape our current notions of learners, learning, and teaching. These researchers review the dynamic field of new and emerging medias and technologies that have the potential of creating unique, possibly until now unfathomable, themes of research in educational psychology. They trace instructional technology from its behavioristic, computer-administered drill and practice roots, to the influence of the cognitive science revolution, with its focus on artificial intelligence and analogies to information processing computing paradigms, to more contemporary situated models of contextualized learning, where cognition is not viewed in a straightforward algorithm, but rather as the emergent property of complex systems working in parallel. They review different analogies used to characterize the influence of computers in education. These perspectives independently have viewed the computer as an information source, as a curriculum domain, as a communication medium, as a cognitive tool, as an alternative learning environment, as a learning partner, as a means of scaffolding learning, and as a tool for perspectivity sharing.

Goldman and colleagues point out significant newly emerging paradigms and the concomitant challenges that will ensue from these dynamic new applications. The idea of perspectivity technologies and their "Points of Viewing Theory" is presented with expansions to the notion that computers allow for elastic knowledge construction. The use of social networking as a vehicle for teaching (Goldman & Dong, 2009) is noted, as is the research on interactive and massive multiplayer games as facilitators of learning (Plass, Homer, & Hayward, 2009).

PSYCHOLOGY IN THE SCHOOLS

Students with special needs have long been a focus of research in educational psychology and a major recipient of the applications of research to practice in educational psychology. From the early applications of Binet and colleagues in France (Binet, 1898; Binet & Henri, 1896; Binet & Simon, 1905) and efforts in the United States (Terman & Childs, 1912; Woolley, 1915) in the development of intelligence tests for the identification of student with exceptional needs who would benefit from special education, educational psychology has informed and addressed the needs of exceptional learners and the applications of psychology in schools.

Work here focuses on the contributions of educational psychology on understanding the school-based and developmental needs of exceptional learners. Within this domain we include the field of school psychology, which includes a major emphasis on the evaluation and development of programs and interventions for exceptional learners. Educational psychology has had an impact on the study of individuals with learning disabilities as well as those of high cognitive ability. Investigations in these areas have ranged from basic processes to applied research on intervention programs. Students who demonstrate behavioral excess represent another important target population for the application of research on classroom management and behavior change supported by educational psychology.

School Psychology

School psychology is a field of psychology that is closely aligned with educational psychology. School psychology is an applied field of psychology, represented in APA by Division 16 (School Psychology) and by other professional organizations, the most visible being the National Association of School Psychologists (NASP). The APA division of School Psychology along with the division of Educational Psychology were among the original 18 divisions created in 1945 with the reorganization of APA. School psychology is dedicated to providing for and ensuring that the educational, behavioral, and mental health needs of children are met in accordance with federal and state legislation. The vast majority of school psychology graduate programs are in departments of educational psychology or schools of education, with most of the remainder found in psychology departments. Similar to the applied and research-based training programs in clinical and counseling psychology, most doctoral training programs follow a scientist-practitioner model, an exception being the unique *scientist-practitioner-scholar* model of training in school psychology formulated by Kratochwill, Gettinger, Reynolds, & Doll, 1988). Gettinger, Brodhagen, Butler, and Schienebeck (this volume) describe how societal events and trends have had a hand in the shaping of school psychology practice and focus over the past century, including events in the early part of the 21st century.

School psychology has been an area of psychology that has experienced a tremendous increase in the number of professionals in the field. Much of the emphasis in the training and practice of school psychology has been directed by the needs of exceptional children in school settings and the guidelines for the provision of services provided by the Individuals with Disabilities Education Act (IDEA) and other federal legislation. There are more than 5 million children and adolescents with educational and emotional disabilities in the nation's schools, representing approximately 1 out of 9 children. School psychologists in the United States have a major role in the direct evaluation and provision of psychological services to these children, illustrating the importance of this branch of psychology to the welfare of young people.

In contemporary school psychology, there has been a major shift in the field from an emphasis on the diagnosis of children referred for learning or behavior problems to the prevention of school failure and promotion of academic success for all children. Consultation has risen as an indirect service delivery system where school psychologists consult with teachers, families, and other professionals to enable them to address the needs or concerns of individual students and to improve the overall learning environment for all students.

Contemporary and future challenges to school psychology are presented by Gettinger and colleagues. School psychology, as a subspecialty of educational psychology, has been at the forefront of calls for the use of empirically supported interventions (see also Levin & Kratochwill, this volume; Stoiber & Kratochwill, 2000), as well as the recognition of mental health needs of schoolchildren. Gettinger and colleagues' chapter serves to illustrate the importance of school psychology in the education of children and an important application of psychology to education.

Gifted Education Programs and Procedures

Olszewski-Kubilius and Thomson (this volume) review research and policy work focused on defining characteristics of gifted children and how this has important implications for the education of the gifted. In addition to our increased knowledge of the striking capabilities of gifted children, there is increasing evidence of considerable inter and intra individual variance—or asynchronous development (Morelock & Feldman, 1993). Gifted students are a heterogeneous group who differ from each other in their developmental pathways and in their distinct profile of abilities.

Olszewski-Kubilius and Thomson note the dilemma that although talent and giftedness are of interest in our society, there currently is no agreed-on definition of giftedness and no federal mandates to serve gifted children. This has contributed to a confused array of services (or lack thereof) available to gifted children in schools. Olszewski-Kubilius and Thomson describe how different concepts of giftedness that have attained eminence in this field have also sparked a great deal of controversy about the role of IQ or intelligence in defining this construct. They note the paradigm shift in the mid- to late 1980s that "went from viewing giftedness as cognitive characteristics residing within the individual, largely determined by IQ or intelligence, to a focus on talent development as a phenomenon with a developmental trajectory that is complex, varies by domain or field, and is significantly influenced by environmental opportunities and psycho-social factors and characteristics" (pp. 389).

Similar to other domains within educational psychology, recent research is more focused on the role of culture and context in defining giftedness. Several sociocultural theories of giftedness suggest behavior is only deemed intelligent or talented if it helps an individual to succeed in a particular context and that context defines what is considered success. They refer to Sternberg (this volume; Sternberg & Davidson, 2005) who posits that wisdom is the most important attribute to develop in gifted individuals. Wisdom involves the application of both intelligence and creativity as mediated by values and a focus on the common good. These authors contrast this with performance-based theories of giftedness or talent and the role of deliberate practice that is not necessarily enjoyable as what may distinguish elite performers from less successful ones. They reject the existence of an abstract construct called *giftedness* and instead explain high levels of achievement by focusing on the acquired nature of talent.

This chapter also examines a theory of giftedness that emphasizes talent development (Gagne, 2009) with giftedness as exceptional natural abilities that, although not innate, appear primarily during the early years of children's development and demonstrate significant individual differences without any clear evidence of systematic learning, training, or practice. Natural abilities in at least one of the six ability domains are considered the building blocks of systematically acquired talents. In this way, one can be gifted and not talented; however, one cannot be talented and not gifted. It is possible that one aptitude can be involved in the development of many different talents, and any talent can use abilities from more than one aptitude domain as its constituents (Gagne, 2003, 2005). Such theories de-emphasize the role of general ability as measured by IQ, and instead stress creative achievement. This proposes stage models for the development of talent that show how individuals progress through the stages of talent development, ability, competence, expertise, and scholarly productivity or artistry.

School-Related Behavior Disorders

The field of behavior disorders in children and adolescents has emerged as a major focus of psychologists, teachers, administrators, state and federal governments, and the general public. With the publication and dissemination of the Surgeon General's report derived from a year 2000 national conference on children's mental health and the needs of this population, there was an increased national awareness of the psychological needs of children and adolescents with behavior problems. Similarly, the needs of children and adolescents with behavior disorders has created a greater need for interventions and adaptations than schools currently can deal with effectively (Shinn & Walker, 2010). As Walker and Gresham (this volume) describe, the widely publicized cases of school shootings and bullying violence by students has galvanized the general public and professionals toward actions aimed at creating safe school environments and an increased acknowledgment of students with extreme emotional and behavioral disturbance, as well as students whose behavioral excess is directed toward their peers. The notion of safe schools is of major concern nationally.

Walker and Gresham provide a critical examination of behavior disorders in children and adolescents by first delineating the current status of the field. This is followed by a discussion of current trends in research and practice in this field that the authors consider to be indicative of best practices, including: functional assessment of behavior, interventions that utilize positive behavioral support, research examining teacher interactions with students with behavior disorders, the association between language deficits and behavior disorders in children, the utility of office referrals as a critical indicator of potential behavior disorders, and resistance to intervention as a cardinal symptom for the determination of treatment eligibility and selection. The authors describe the Positive Behavior Intervention and Supports (PBIS) program, which has demonstrated efficacy in providing services to children with emotional and behavioral disabilities and has been adopted by schools across the nation. Walker and Gresham also describe a number of problems in the field of behavior disorders, most of which are at a policy or practice level. These include: political turmoil in the field of behavior disorders as a specialty area, limited translation of quality research on major problems in the field to everyday practice, and the larger role of creating safe and healthy school environments; the propensity for postmodern and deconstructivist perspectives that devalue scientific research to be adopted by behavior disorder professionals; the general failure of schools to serve the needs of students with behavior disabilities, in part due to interpretation of federal education legislation; and lastly, the relative lack of attention by professionals and leaders in the field to early identification and prevention activities.

Instrumental to the provision of appropriate services is the utilization of well-researched interventions for the treatment of behavior disorders in children and adolescents in school settings. The authors provide an argument for the use of social skills instruction with appropriate inclusion of procedures to modify maladaptive behaviors, and describe the application of universal intervention programs that may assist in the prevention of more serious emotional and behavioral problems in children and adolescents.

PERSPECTIVES ON EDUCATIONAL PROGRAMS, RESEARCH, AND POLICY

Educational psychology has had a significant role in the development and reform of educational practices. An important contribution of educational psychology is the knowledge and guidance provided to the education of teachers. As noted earlier, courses in educational psychology are required in most university teacher preparation programs. An examination of introductory textbooks in educational psychology shows a strong preference toward teachers as their primary audience. Hoy (2000) observed that it is through textbooks in educational psychology that we can see what the general public and teachers learn about the application of psychology to teaching and related educational activities. The significant breadth of methodological knowledge that educational psychologists bring to the political reform table has been influential in stressing the need for credible school-based intervention research. In this respect, educational psychology acts as the conduit to introduce and apply research and principles of psychology to educational practices. The role of educational psychologists will continue to be an important and credible voice in resolving ongoing controversies critical to the advancement and application of knowledge for educational practice.

Learning and Pedagogy in Initial Teacher Preparation

There is little doubt that teachers in most cases play the ultimate role in the education of children, a responsibility of enormous importance. For the education of young people, teachers are expected to be experts in classroom management, curriculum, and instruction, creating classroom environments that are physically and psychologically motivating, and transmitting knowledge. Learning to teach is arguably one of the most cognitively and emotionally challenging efforts one can undertake and new teachers face greater challenges than ever before with today's diverse student needs, public scrutiny, and political pressures (Whitcomb, this volume). There is a critical need to prepare more teachers than ever before and there are deeply divided ideas about best practice for initial teacher preparation (Darling-Hammond, Wei, & Johnson, 2009; Hess, Rotherham, & Walsh, 2004). Whitcomb reviews the empirical work on initial teacher preparation, and the multiple perspectives that have emerged over the past 20 years on how to teach future teachers to teach.

What do initial teachers need to know? Whitcomb reviews and synthesizes that large body of work dedicated to establishing teaching as a learning profession (Darling-Hammond, 2006). Teaching is now viewed as a profession with a complex and distinguished knowledge base. Current research is focused on the integrated processes and judgments teachers use to navigate this breadth of information. Whitcomb narrows the focus of this chapter to a critical review of cognitively oriented studies of new teacher's learning. There is an emphasis on what is known about the essential knowledge base for new teachers and how teachers learn across diverse contexts.

From the early 1980s, educational researchers have focused on building an understanding of the specialized knowledge base required to effectively teach content in multiple ways to diverse learners. This work has been strongly influenced by the work of educational psychologists working within social constructivist models that view physical and social contexts as integral parts of any cognitive endeavor. Research in this tradition stresses that the situations and social environments within which they are learned influence skills and that such situated knowledge becomes a fundamental part of what is learned.

Currently there is a move away from studying an individual teacher's knowledge to studies that focus on interactive systems as the unit of analysis (Putnam & Borko, 2000). Recent work has focused on the dispositions that underlie good teaching: how teachers become committed to students, to meeting individual student needs, and to monitoring their own and their students' learning. In this respect, teaching and teachers are viewed as part of learning communities that require judgment and ongoing, flexible decision making to support student learning in culturally inclusive settings. Researchers are now examining how teachers learn to teach—how they actively construct a personal knowledge-base and then use it to guide everyday classroom judgments and learning. These contemporary efforts are critically relevant to initial teacher preparation.

Whitcomb describes the need for attention to critical research that demonstrates the effectiveness of teacher education programs, noting the communalities between this and the general calls for greater rigor in educational programs. She describes this debate as illustrated in reports by the National Research Council (Shavelson & Towne, 2002; Towne, Wise, & Winters, 2004), which sought to determine what constitutes empirically based practice and how this should inform practice. Teacher education, which as many of the chapters in this volume suggest, is tremendously complex given the multiplicity of learner, environment, and teacher characteristics and their interactions.

In reviewing the research on teacher education, Whitcomb focuses on current research on beginning teachers or teacher candidates, with particular reference to research based on cognitive or "situative" psychological foundations. Initial teacher preparation has substantially changed over the past two decades in multiple domains of instruction as new learning environments are developed and the changing influence of social and digital media on student as well as teacher learning is integrated into curriculums. Whitcomb builds on the work of others in educational psychology (e.g., Borko & Putnam, 1996; Putnam & Borko, 1997, 2000), and also examines the field of initial teacher preparation and how this field determines whether a teacher candidate meets the standards of the profession. This latter issue is of major importance, given that national mandates for student education, such as No Child Left Behind, include a significant focus on the role and competence of teachers in the education of students.

The chapter ends with a critical analysis of the limits of current research and the need for stronger empirical work to enhance our understanding of initial teacher pedagogy in the future. The conclusion drawn from this review is that educational psychologists are in a unique position to influence and conduct rigorous inquiry that will further unravel the complexity of teaching and contribute to the development of effective initial teacher preparation models.

Educational Programs, Research, and Policy

Educational psychology has, for more than a century, been at the forefront in the development of research methodologies and statistics. Educational psychologists have been active in the fields of educational measurement, statistics, and research designs, and in the application of these methodologies to educational programs and policy. Notable journals in this field include the *Journal of Educational Measurement*, *Educational and Psychological Measurement*, *Journal of Educational Statistics*, *Applied Psychological Measurement*, *Educational Assessment*, and others that have as a primary focus the presentation of new measurement, statistical, and research methodologies. In the chapter by Levin and Kratochwill (this volume), a provocative argument is made that stresses the need for more credible, rigorous standards in the conceptualization, design, and evaluation of educational/psychological treatments and interventions. Levin and O'Donnell (1999), after reviewing the thoughts of many prior editors and presidents representing the field of educational psychology, noted collective concerns about the nature and quality of educational research and the preparation of the next generation of researchers.

Educational psychology, more than ever before, is expected to improve our ability to understand, predict, and control human behavior as well as our ability to design instructional practices with potential applications to problems of schooling. Recognizing the inherent difficulties in conducting educational research and the importance of bridging many different communities across a wide array of academic disciplines, there was a call for a broader array of naturalistic and empirical methodologies, ranging from case studies and observations to multivariate designs and analyses (Wittrock, 1994). Contemporary methodological debates about qualitative and quantitative or applied and basic inquiry oversimplify and trivialize the issue of how to best obtain quality supportive evidence using a variety of rigorous inquiry standards that could be reflected in any methodological orientation.

This past decade has seen a broad mandate in most fields of psychology and education for the development and documentation of evidence-based interventions and practices (e.g., American Psychological Association Presidential Task Force on Evidence-Based Practice, 2006; American Psychological Association Presidential Task Force on Evidence-Based Practice for Children and Adolescents, 2008; Kratochwill & Shernoff, 2003). The focus on empirical evidence for interventions was highlighted by Levin and Kratochwill in their examination of four prototypic research designs that permeate the literature: the case study, the demonstration study, observational/correlational studies, and design research.

The acronym CAREful research is used to review components of scientific integrity that can enhance the evidence credibility of educational research. A framework for conceptualizing different stages of such research is forwarded and promising methodological developments in instructional research are reviewed. Preliminary phases of inquiry place a fundamental value on subjective, reflection, intuition, and observation as important steps for guiding further inquiry using objective, scientifically credible methodology in order to make valid prescriptions for future intervention. These authors also argue that just as medical research requires credible evidence of therapeutic benefits, so do educational and psychological research. Trustworthy and credible instructional research to assess the relative impact of educational and psychological treatments or interventions is of critical importance for policy makers. Indeed, as Levin (1994) eloquently argued, the future viability of the field will depend on our ability to craft educational intervention research that is both credible and creditable. This is a continuing conundrum for the field. The development of such innovative methodological continuums should become a top priority for future educational researchers. Likewise, the need to adopt educational programs and interventions that have proved credible based on scientifically viable methodology continues to be a significant issue in education.

Educational Psychology and Educational Transformation

Educational psychology as a discipline has from its inception sought to inform and help guide the education of students and the development of local and national education policies and reforms. Educational psychology has accomplished this by maintaining a strong linkage to credible school-based research and associated methodologies. McCombs (this volume) illustrates how research in educational psychology can be translated to changes in educational practice, with a particular reference to how teachers can be informed by research to modify and enhance their classroom and instructional procedures.

McCombs discusses learner-centered instruction (McCombs, in press; McCombs & Whisler, 1997; McCombs & Miller, 2007), a set of practices that are designed to enable teachers to gain an understanding of cognitive and metacognitive factors in learning, motivational and emotional influences on learning, developmental and social influences on learning, and individual differences in learning and evaluation (APA Work Group of the Board of Educational Affairs, 1997). These principles were designed to provide teachers with a set of practices that focus on the learner, including an understanding of individual differences and diversity of learners and learner styles. The principles originated with the 1990 appointment by the American Psychological Association of a Task Force on Psychology in Education that sought to provide for the application of psychological research and theory to learning in educational contexts. Research over the past several decades on learner-centered practices that confirms the impact of teacher-centered instruction on positive students' and teachers' positive emotions in school settings (McCombs & Miller, 2007).

McCombs (this volume) discusses current and emerging principles in the field that have been derived from more integrated educational psychological research occurring across diverse fields. The ideas she has illuminated encourage both new and current researchers to engage in collaborative efforts using innovative research models and methods that have the greatest potential of impacting research, practice, and policy. The educational transformation ideas she has forwarded have a strong basis in new learning technologies and professional development models for the 21st century. Similar to research discussed by other contributors, McCombs notes that research continues to reveal the social nature of learning along with sociocultural and other contextual factors. As example, she cites Lee and Shute (2010) who reviewed personal and sociocontextual factors affecting the performance of K–12 children and concluded that personal factors (behavior, affect, attitude, and cognition) as well as their sociocontextual environment as predictors worked together to create optimal school performance, particularly in the areas of reading and mathematics. This chapter clearly delineates the interaction between educational research and policy, and encourages both new and current researchers to engage in collaborative efforts using innovative research models and methods that have the greatest potential of impacting educational research, practice, and policy.

Future Perspectives in Educational Psychology

In writing their chapters for this book, contributors were asked to provide insight as to what future trends and directions were anticipated for their respective field of inquiry. By synthesizing these ideas, Miller and Reynolds (this volume) sought to highlight critical theoretical, research, and practical issues likely to inform and direct the field of educational psychology well into the 21st century. Seven thematic areas were identified that are likely to continue to impact theory and application and to influence and inform educational researchers, practitioners, and policy makers well into the future. The issues within these areas uniformly surfaced across a majority of chapters and are considered due to their potential of advancing our understanding of individual learners and learning contexts; interpersonal, relational, and instructional processes; curriculum development; and teacher preparation. Implications are presented for translating theory into educational practice supported by exemplars posed by authors in this volume.

The chapter concludes with an overview of prospective issues relevant to transforming a vast empirical knowledge base into sound educational policy and practice. The research advances highlighted within each of these areas have been linked to effective schooling and improved school outcomes for a broad range of students and clearly point to exciting educational recommendations.

A strong conclusion is drawn that the work of educational psychologists is likely to play an even greater future role in guiding 21st-century educational policy and reform to improve schooling outcomes for all children.

SUMMARY

Educational psychology focuses in large part on the application of psychology to the understanding of learners and learning environments. However, such a broad generalization of the field does not do justice to the myriad of domains and applications represented by this field of psychology. As this introduction to the field and to this volume in the *Handbook of Psychology* illustrates, the field of educational psychology represents an important area of psychological research, theory, and practice.

The five major areas of contemporary research and practice in educational psychology covered in this volume include cognitive and regulatory contributions to learning, development, and instruction; sociocultural, instructional, and relational processes; early education and curriculum applications; psychology in the schools; and educational programs, research, and policy. The individual chapters within these broad areas provide for coverage of nearly all the domains identified by Pressley and Roehrig as having the most significant impact on the field of educational psychology.

Individually, each chapter describes a rich domain of research, and almost universally, each notes a burgeoning of new research paradigms, perspectives, theories, and major conceptualizations that have emerged over the past 20 years as well as the renewed emphasis on scientifically sound research methodologies. It is noteworthy that some of these new insights into human behavior and psychology applied to education have been predicated on recognized and acknowledged contributions made by psychologists (e.g., Vygotsky) in the early part of the 20th century. Although the scope of educational psychology as a field of psychology is quite broad, there are numerous communalities that can be seen across the varied chapters of this volume. These communalities suggest a connectedness that supports educational psychology as a rich and vital field of scientific inquiry.

The influence and impact of research in educational psychology on society is probably best recognized by applications to the education and training of teachers and the development of procedures to enhance classroom instruction and learning, how we motivate learners, and the integration of new technology into the classroom and beyond. These and other applications in educational psychology are buttressed by an empirical rigor of research methods in the design of both basic and applied experiments and field-based investigations. It is evident that researchers in educational psychology are addressing major issues related to the education of learners in regular and special education contexts. In addition to the impact of educational psychology on learning and learners, it has also played a major role in informing policy and educational reform.

The mosaic of educational psychology is well represented by the authors of this volume and their respective chapter contributions. The sum of knowledge presented in the chapters of this volume illustrates the diversity of research and practice domains. This introduction to current perspectives in educational psychology provides a snapshot of the breadth and scope of this field but does not do justice to the depth of research and applications. For the latter, the following chapters provide excellent description, evaluation, and synthesis. The dynamic nature of this field of psychology is evident across the chapters and serves to illustrate the importance of educational psychology research and practice to individuals and society. It is our expectation that this importance will continue and grow in the 21st century.

REFERENCES

Ainsworth, M. D., Blehar, M. C., Waters, E., & Wall, D. (1978). *Patterns of attachment: A psychological study of the strange situation*. Hillsdale, NJ: Erlbaum.

American Psychological Association Board of Educational Affairs. (1995). *Learner-centered principles: A framework for school redesign and reform.* Washington, DC: American Psychological Association.

American Psychological Association Work Group of the Board of Educational Affairs (1997, November). *Learner-centered psychological principles: A framework for school reform and redesign*. Washington, DC: American Psychological Association.

American Psychological Association Presidential Task Force on Evidence-based Practice (2006). Evidence-based practice in psychology. *American Psychologist, 61*, 271–285.

American Psychological Association Task Force on Evidence-Based Practice for Children and Adolescents (2008). *Disseminating evidence-based practice for children and adolescents: A systems approach to enhancing care*. Washington, DC: American Psychological Association.

Ames, C. (1984). Competitive, cooperative, and individualistic goal structures: A motivational analysis. In R. Ames & C. Ames (Eds.), *Research in motivation in education* (Vol. 1, pp. 117–207). New York, NY: Academic Press.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivational processes. *Journal of Educational Psychology, 80*, 260–270.

Anderman, E. M., & Anderman, L. H. (2010). *Classroom motivation*. Upper Saddle River, NJ: Pearson.

Anderson, R. C., & Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading comprehension. In P. D. Pearson (Ed.), *Handbook of reading research* (pp. 225–291). New York, NY: Longman.

Bakeman, R., & Gottman, J. M. (1986). *Observing interaction: An introduction to sequential analysis*. Cambridge, MA: Cambridge University Press.

Bandura, A. (1969). *Principles of behavior modification*. New York, NY: Holt.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavior change. *Psychological Review, 84*, 191–215.

Bandura, A. (1982). Self-efficacy mechanisms in human agency. *American Psychologist, 37*, 122–147.

Barnett, D. W., VanDerHeyden, A. M., & Witt, J. C. (2007). Achieving science-based practice through response to intervention: What it might look like in preschools. *Journal of Educational and Psychological Consultation, 17*, 31–54.

Beatty, B. (1998). From laws of learning to a science of values: Efficiency and morality in Thorndike's educational psychology. *American Psychologist, 53*, 1145–1152.

Berliner, D. C., & Calfee, R. (Eds.). (1996). *Handbook of educational psychology*. New York, NY: Macmillan.

Binet, A., & Henri, V. (1896). La psychologie individuelle. *L'Annee Psychologique, 2*, 411–465.

Binet, A. (1898). La mesure en psychologie individuelle. *Revue Philosophique, 46*, 113–123.

Binet, A., & Simon, T. (1905). Application des methodes nouvelles au diagnostic du niveau intellectuel chez des enfants normaux et anormaux d'hospice et d'ecole primaire. *L'Annee Psychologique, 11*, 255–336.

Borko, H., & Putnam, R. T. (1996). Learning to teach. In D. C. Berliner, & R. C. Calfee (Ed.), *Handbook of educational psychology* (pp. 673–708). New York, NY: Macmillan.

Bowlby, J. (1969). *Attachment and loss, Vol 1: Attachment*. New York, NY: Basic Books.

Brainerd, C. J. (1978). Cognitive development and instructional theory. *Contemporary Educational Psychology, 3*, 37–50.

Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology (5th ed.): Theoretical models of human development* (pp. 993–1028). New York, NY: Wiley.

Brophy, J., & Good, J. L. (1974). *Teacher-student relationships*. New York, NY: Holt, Rinehart, & Winston.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2*, 141–178.

Bruner, J. S. (1960). *The process of education*. Cambridge, MA: Harvard University Press.

Bruner, J. S. (1966). *Toward a theory of instruction*. London, UK: Belnap.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis issues for field settings*. Boston, MA: Houghton Mifflin.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297–301.

Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L., Wei, R. C., & Johnson, C. M. (2009). Teacher preparation and teacher learning: A changing policy landscape. In G. Sykes, B. L. Schneider, & D. N. Plank (Eds.), *Handbook of education policy research* (pp. 613–636). New York, NY: New Press.

Dewey, J. (1916). *Democracy and education*. New York, NY: Macmillan.

Eccles, J. S. (2005). Subjective task values and the Eccles et al. model of achievement related choice. In A. J. Elliott & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). New York, NY: Academic Press.

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development, 76*, 1055–1071.

Fast, L. A., Lewis, J. L., Bryant, M. J., Bocian, K. A., Cardullo, R. A., Rettig, M., & Hammond, K. A.. (2010). Does math self-efficacy mediate the effect of the perceived classroom environment on standardized math test performance? *Journal of Educational Psychology, 102*, 729–740.

Flavell, J. H. (1963). *The developmental psychology of Jean Piaget*. Princeton, NJ: van Nostrand.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), The nature of intelligence (pp. 231–236). Hillsdale, NJ: Erlbaum.

Flower, L., & Hayes, J. R. (1980). The dynamics of composing: Making plans and juggling contraints. In L. Gregg & E. Steinberg (Eds.), *Cognitive processes in writing* (pp. 31–50). Hillsdale, NJ: Erlbaum.

Gagne, F. (2003). Transforming gifts into talents: The DMGT as a developmental theory. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education.* (3rd ed., pp. 60–87). Boston, MA: Pearson.

Gagne, F. (2005). From gifts to talents: The DMGT as a developmental model. In R. J. Sternberg & J. E. Davis (Eds.), *Conceptions of giftedness.* (2nd ed., pp. 98–119). New York, NY: Cambridge University Press.

Gagne, F. (2009). Building gifts into talents: Detailed overview of the DMGT 2.0. In B. McFarlane & T. Stambaugh (Eds.), *Leading change in gifted education* (pp. 61–80). Waco, TX: Prufrock Press.

Goldman, R., & Dong, C. (2009). Linking the POV-ing theory to multimedia representations of teaching, learning, and research in the age of social networking. In L. Moller & D. H. Harvey (Eds.), *Learning and instructional technologies for the 21st century: Visions of the future.* New York, NY: Springer.

Graesser, A. C. (2009). Inaugural editorial for Journal of Educational Psychology. *Journal of Educational Psychology, 101*, 259–261.

Graesser, A. C., Halpern, D. F., & Hakel, M. (2008). *25 principles of learning*. Washington, DC: Task Force on Lifelong Learning at Work and at Home. www.psyc.memphis.edu/learning/whatweknow/index.shtml

Graesser, A. C., McNamara, D. S., & Kulikovich, J. M. (2011). Coh-Metrix: Providing multilevel analysis of text characteristics. *Educational Researcher, 40*, 223–234.

Grant, G., & Murray, C. (1999). *Teaching in America: The slow revolution*. Cambridge, MA: Harvard University Press.

Halstead, W. C. (1951). Biological intelligence. *Journal of Personality, 20*, 118–130.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72*, 625–638.

Hamre, B. K., & Pianta, R. C. (2005). Can instructional and emotional support in the first grade classroom make a difference for children at risk of school failure? *Child Development, 76*, 949–967.

Harackiewicz, J. M., Barron, K. E., Pintrich, P. R., Elliot, A. J., & Thrash, T. M. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology, 94*, 638–645.

Harris, K. R., Graham, S., & Urdan, T. (in press). *APA Handbook of educational psychology*. Washington, DC: American Psychological Association.

Hebb, D. O. (1949). *The organization of behavior: A neuropsychological theory*. New York, NY: Wiley.

Hess, F. H., Rotherham, A. J., & Walsh, K. (Eds.). (2004). *A qualified teacher in every classroom? Appraising old answers and new ideas*. Cambridge, MA: Harvard Education Press.

Hilgard, E. R. (1996). History of educational psychology. In D. C. Berliner & R. Calfee (Eds.), *Handbook of educational psychology* (pp. 990–1004). New York, NY: Macmillan.

Hoy, A. W. (2000). Educational psychology in teacher education. *Educational Psychologist, 35*, 257–270.

Huey, E. B. (1900). On the psychology and physiology of reading: I. *American Journal of Psychology, 11*, 283–302.

Huey, E. B. (1901). On the psychology and physiology of reading: II. *American Journal of Psychology, 12*, 292–312.

Huey, E. B. (1908). *On the psychology and pedagogy of reading, with a review of the history of reading and writing and of methods, texts, and hygiene in reading*. New York, NY: Macmillan.

Hunt, J. M. (1961). *Intelligence and experience*. New York, NY: Roland Press.

Hurley, E. A. (1997, April). *The interaction of communal orientation in African-American children with group processes in cooperative learning: Pedagogical and theoretical implications.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Inhelder, B., Sinclair, H., & Bovet, M. (1974). *Learning and the development of cognition* (Trans. S. Wedgwood). Cambridge, MA: Harvard University Press.

Jaeger, R. M., & Bond, L. (1996). Quantitative research methods and design. In D. C. Berliner & R. Calfee (Eds.), *Handbook of educational psychology* (pp. 877–898). New York, NY: Macmillan

James, W. (1890). *The principles of psychology*. New York, NY: Henry Holt and Company.

James, W. (1899). *Talks to teachers on psychology-and to students on some of life's ideals*. New York, NY: Henry Holt and Company.

Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika, 23*, 187–200.

Kamil, M., Pearson, P. D., Moje, E., & Afflerbach, P. (Eds.). (2011). *Handbook of reading research* (Vol. 4). London, UK: Routledge.

Kintsch, W. (1989). Learning from text. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 25–46). Hillsdale, NJ: Erlbaum.

Kratochwill, T. R., Gettinger, M., Reynolds, W. M., & Doll, E. J. (1988). School psychology at the University of Wisconsin–Madison. *Professional School Psychology, 3*, 93–107.

Kratochwill, T. R. & Shernoff, E. S. (2003). Evidence-based practice: Promoting evidence-based interventions in school psychology. *School Psychology Quarterly, 18,* 389–408.

Lambert, N. M., & McCombs, B. L. (Eds.) (1998). *How students learn: Reforming schools through learner-centered instruction*. Washington, DC: American Psychological Association.

Lee, J., & Shute, V. J. (2010). Personal and social-contextual factors in K-12 academic performance: An integrative perspective on student learning. *Educational Psychologist, 45*, 185–202.

Lehrer, R., & Schauble, L. (2007). A developmental approach for supporting the epistemology of modeling. In W. Blum, P. L. Galbraith, H-W. Henn, & M. Niss (Eds.), *Modeling and applications in mathematics education*. (pp. 153–160). New York, NY: Springer.

Lehrer, R., & Schauble, L. (2005). Developing modeling and argument in elementary grades. In T. A. Romberg, T. P. Carpenter, & F. Dremock (Eds.), *Understanding mathematics and science matters* (pp. 29–53). Mahwah, NJ: Erlbaum.

Lesh, R., & Harel, G. (in press). Problem solving, modeling and local conceptual development. Models and modeling in mathematics education. *International Journal for Mathematical Thinking and Learning*.

Levin, J. R. (1973). Inducing comprehension in poor readers: A test of a recent model. *Journal of Educational Psychology, 65*, 19–24.

Levin, J. R. (1994). Crafting educational intervention research that's both credible and creditable. *Educational Psychology Review, 6*, 231–243.

Levin, J. R., & O'Donnell, A. M. (1999). What to do about educational research's credibility gaps? *Issues in Education: Contributions from Educational Psychology, 5*, 177–229.

Lindquist, E. F. (1940). *Statistical analysis in educational research*. Boston, MA: Houghton Mifflin.

Loeber, R. (1990). Development and risk factors of juvenile antisocial behavior and delinquency. *Clinical Psychology Review, 10*, 1–41.

Luria, A. R. (1961). *The role of speech in the regulation of normal and abnormal behaviors*. New York, NY: Liverwright.

Luria, A. R. (1980). *Higher cortical functions in man* (2nd ed., rev. & expanded). New York, NY: Basic Books.

Mahn, H., & John-Steiner, V. (2005). Vygotsky's contribution to literacy research. In R. Beach, J. L. Green, M. L. Kamil, & T. Shanahan (Eds.), *Multidisciplinary perspectives on literacy research* (2nd ed.) Urbana, IL: National Council of Teachers of English.

Mayer, R. E. (1976). Integration of information during problem solving due to a meaningful context of learning. *Memory & Cognition, 4*, 603–608.

McCombs, B. L. (in press). The Learner-centered psychological principles: A framework for balancing a focus on academic achievement with a focus on social and emotional learning needs. In J. E. Zins, R. P. Weissberg, M. C. Wang, & H. J. Walberg (Eds.), *Building school success on social and emotional learning.* New York, NY: Teachers College Press.

McCombs, B. L., & Miller, L. (2007). *Learner-centered classroom practices and assessments: Maximizing student motivation, learning, and achievement.* Thousand Oaks, CA: Corwin Press.

McCombs, B. L., & Whisler, J. S. (1997). *The learner-centered classroom and school: Strategies for increasing student motivation and achievement*. San Francisco, CA: Jossey-Bass.

Meichenbaum, D. (1977). *Cognitive behavior modification: An integrative approach.* New York, NY: Plenum Press.

Miller, G. A., Galanter, G. A., & Pribram, K. H. (1960). *Plans and the structure of behavior*. New York, NY: Adams Bannister Cox.

Miller, G. E., & Reynolds, W. M. (2003). Future perspectives in educational psychology. In W. M. Reynolds & G. E. Miller (Vol. Eds.), *Educational psychology* (pp. 609–630). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Morelock, M. J., & Feldman, D. H. (1993). Prodigies and savants: What they have to tell us about giftedness and human cognition. In K. A. Heller, F. J. Monks, & A. H. Passow (Eds.), *International handbook of research and development of giftedness and talent* (pp. 161–181). Elmsford, NY: Pergamon.

National Scientific Council on the Developing Child. (2004). Children's emotional development is built into the architecture of their brains: *Working paper No. 2*. Retrieved from www.developingchild.harvard.edu

National Scientific Council on the Developing Child. (2007). The timing and quality of early experiences combine to shape brain architecture: *Working paper No. 5*. Retrieved from www.developingchild.harvard.edu

National Institute of Child Health & Human Development. (2000). *Report of the national reading panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction.* (NIH Publication No. 00-4769). Washington, DC: U. S. Government Printing Office.

Paivio, A. (1971). *Imagery and verbal processes*. New York, NY: Holt, Rinehart, & Winston.

Pearson, P. D. (2007). An historical analysis of the impact of educational research on policy and practice: Reading as an illustrative case. In D. W. Rowe, R. T. Jiménez, D. L. Compton, D. K. Dickinson, Y. Kim, K. M. Leander, & V. J. Risko, (Eds)., 56th yearbook of the national reading conference (pp. 14–40). Oak Creek, WI: National Reading Conference.

Pearson, P. D., & Hiebert, E. (2010). National reports in literacy: Building a scientific base for practice and policy. *Educational Researcher, 39*, 286–294.

Peterson, E., Faucher, T. A., & Eaton, W. W. (1978). A new perspective on the effects of first grade teachers on children's subsequent adult status. *Harvard Educational Review, 48*, 1–31.

Pianta, R. C. (1999). *Enhancing relationships between children and teachers*. Washington, DC: American Psychological Association.

Pianta, R. C., Hamre, B., & Stuhlman, M. (2003). Relationships between teachers and children. In W. M. Reynolds & G. E. Miller (Vol. Eds.), *Educational psychology* (pp. 199–234). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Pintrich, P. R. (2003). Motivation and classroom learning. In W. M. Reynolds & G. E. Miller (Vol. Eds.), *Educational psychology* (pp. 103–122). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Plass, J. L., Homer, B. D., & Hayward, E. (2009). Design factors for educationally effective animations and simulations. *Journal of Computing in Higher Education, 21*, 31–61

Polya, G. (1957). *How to solve it* (2nd ed.). Princeton, NJ: Princeton University Press.

Pressley, M., & Roehrig, A. (2002). Educational psychology in the modern era: 1960 to the present. In B. Zimmerman & D. Schunk (Eds.), *Educational psychology: A century of contributions* (pp. 333–366). Mahwah, NJ: Erlbaum.

Putnam, R. T., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good, & I. F. Goodson (Eds.), *International handbook of teachers & teaching* (Vol. II, pp. 1223–1296). Dordrecht: Kluwer.

Putnam, R., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29*, 4–15.

Reynolds, A., Temple, J., White, B., Ou, S., & Robertson, D. (2011). Age 26 cost-benefit analysis of the child-parent center early education program. *Child Development, 82*, 379–404.

Rohwer, W. D. (1970). Images and pictures in children's learning: Research results and educational implications. *Psychological Bulletin, 73*, 393–403.

Rosenthal, R. (1969). Interpersonal expectations effects of the experimenter's hypothesis. In R. Rosenthal & R. L. Rosnow (Eds.), *Artifact in behavioral research* (pp. 182–279). New York, NY: Academic Press.

Rosenthal, T. L., & Zimmerman, B. J. (1978). *Social learning and cognition*. New York, NY: Academic Press.

Rutter, M. (1987). Psychosocial resilience and protective mechanisms. *American Journal of Orthopsychiatry, 57*, 316–331.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals and understanding: An inquiry into human knowledge structures*. Hillsdale, NJ: Erlbaum.

Schoenfeld, A. H. (1985). Making sense of "out loud" problem-solving protocols. *Journal of Mathematical Behavior, 4*, 171–191.

Schoenfeld, A. H., & Pearson, P. D. (2009). The reading and math wars. In G. Sykes, B. Schneider, & D. Plank (Eds.), *Handbook of education policy research* (pp. 560–580). New York, NY: Routledge.

Schunk, D. H., & Zimmerman, B. J. (2008). *Motivation and self-regulated learning: Theory, research, and applications*. Mahwah, NJ: Erlbaum.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston, MA: Houghton Mifflin.

Shavelson, R. J., & Towne, L. (Eds.). (2002). Scientific research in education. Washington, DC: National Research Council, National Academy Press.

Shinn, M. R., & Walker, H. M. (Eds.). 2010. *Interventions for achievement and behavior problems in a three-tier model including RTI*. Bethesda, MD: National Association of School Psychologists.

Slavin, R. E. (1995). *Cooperative learning: Theory, research, and practice* (2nd ed.). Boston, MA: Allyn & Bacon.

Snowling, M., & Hulme, C. (Eds). (2005). *The science of reading: A handbook*. Oxford, UK: Blackwell.

Squires, J. (2010). Designing and implementing effective preschool programs: A linked systems approach for social emotional early learning. In M. Shinn & H. Walker (Eds.), *A three tier approach to prevention of behavior problems* (pp. 293–312). Bethesda, MD: National Association of School Psychologists.

Sternberg, R. J., & Davidson, J. E. (Eds.). (2005). *Conceptions of giftedness. Second edition*. New York, NY: Cambridge University Press.

Stoiber, K. C., & Kratochwill, T. R. (2000). Empirically-supported interventions and school psychology: Rationale and methodological issues-Part I. *School Psychology Quarterly, 15*, 75–105.

Temple, J., & Reynolds, A. (2007). Benefits and costs of investments in preschool education: Evidence from the child-parent centers and related programs. *Economics of Education Review, 26*, 126–144.

Terman, L. M., & Childs, H. G. (1912). Tentative revision and extension of the Binet-Simon measuring scale of intelligence. *Journal of Educational Psychology*, *3*, 61, 133, 198, 277.

Thorndike, E. L. (1903). *Educational psychology*. New York, NY: Lemcke & Buechner.

Thorndike, E. L. (1910). The contribution of psychology to education. *Journal of Educational Psychology, 1*, 5–12.

Towne, L., Wise, L., & Winters, T. (Eds.). (2004). *Advancing scientific research in education*. Washington, DC: National Research Council, National Academy Press.

Tulving, E., & Donaldson, W. (1972). *Organization of memory*. New York, NY: Academic Press.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1*, 3–14.

Vygotsky, L. S. (1926/1997). *Educational psychology*. Jamaica Hills, NY: Saint Lucie Press.

Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes,* M. Cole, V. John-Steiner, S. Scribner, & E. Souerman, Eds. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1981). The instrumental method in psychology. In J. V. Wertsch (Ed.), *The concept of activity in Soviet psychology.* Armonk, NY: Sharpe.

Vygotsky, L. S. (1987). *The collected works of L. S. Vygotsky: Vol. 1. Problems of general psychology* (R. W. Rieber & A. S. Carton, Eds.). New York, NY: Plenum Press.

Vygotsky, L. S. (1993). *The collected works of L. S. Vygotsky: Vol. 2. The fundamentals of defectology (abnormal psychology and learning disabilities)* (R. W. Rieber & A. S. Carton, Eds.). New York, NY: Plenum Press.

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology, 71*, 3–25.

Wentzel, K. R. (2003). School adjustment. In W. M. Reynolds, & G. E. Miller (Eds.) *Handbook of psychology: Educational psychology, Vol. 7,* pp. 235–258. Hoboken, NJ: Wiley.

Wentzel, K. R. (2004). Understanding classroom competence: The role of social-motivational and self-processes. In R. Kail (Ed.), *Advances in child development and behavior* (Vol. 32, pp. 213–241). New York, NY: Elsevier.

Wentzel, K. R., & Wigfield, A. (2007). Motivational interventions that work: Themes and remaining issues. *Educational Psychologist Special Issue: Promoting Motivation at School: Interventions That Work*, *42*, 261–271.

Wentzel, K. R., & Wigfield, A. (2009). *Handbook of motivational at school*. New York, NY: Routledge/Taylor & Francis.

Werner, E., & Smith, R. (1980). *Vulnerable but invincible*. New York, NY: Wiley.

Winne, P. H., & Nesbit, J. C. (2010). The psychology of academic achievement. *Annual Review of Psychology, 61*, 653–678.

Wittrock, M. C. (1994). An empowering conception of educational psychology. *Educational Psychologist, 27,* 129–141.

Woolley, H. T. (1915). A new scale of mental and physical measurements for adolescents and some of its uses. *Journal of Educational Psychology, 6*, 521–550.

Yeager, D. S., & Walton, G. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research, 81*, 267–301.

Zajac, K., & Kobak, R. (2006). Attachment. In G. G. Bear & K. M. Minke (Eds.), *Children's needs III: Development, prevention and intervention* (pp. 379–389). Washington, DC: National Association of School Psychologists.

Zimmerman, B. J., & Schunk, D. H. (2004). Self-regulating intellectual processes and outcomes: A social cognitive perspective. In D. Y. Dai & R. J. Sternberg (Eds.), *Motivation, emotion, and cognition: Integrative perspectives on intellectual functioning and development* (pp. 323–350). Mahwah, NJ: Erlbaum.

CHAPTER 2

Contemporary Theories of Intelligence

ROBERT J. STERNBERG

Hundreds of tests of intelligence are currently available to those who wish to test intelligence. Some are household names; others are known only to small groups of aficionados. Can such tests be justified in terms of psychological theory? If so, what are the theories, and what is the evidence in favor of them? Do all the theories lead to the same kinds of tests, or might alternative theories lead to different kinds of tests? And if alternative theories lead to different kinds of tests, might people's fates be changed if other types of tests are used? These are the kinds of questions that are addressed in this chapter.

This chapter is divided into four parts following this introduction. First, I argue that theories of intelligence matter not only in theory, but also in practical everyday life. The ways in which these theories matter has a profound effect on societies, including that of the United States. Second, classical theories of intelligence are presented and critically evaluated. They are presented not only for historical purposes. Rather, they are presented because these theories continue to be highly influential in the contemporary world, much more so than many contemporary theories. Their influence is contemporary, even though their origins are in the past. Third, contemporary theories of intelligence are presented and critically evaluated. There are many such theories, but consistent with the topic of the volume in which this chapter is embedded, the emphasis is on those theories that have some kind of educational impact. Fourth, the chapter presents some challenges to all current conceptions of intelligence and draws some conclusions. The second and third parts of the chapter are each divided into two sections. One section considers *implicit theories* of intelligence, or people's informal conceptions of what intelligence is. A second section considers *explicit theories* of intelligence, or experts' formal conceptions of what intelligence is. Each part considers the extent to which implicit and explicit theories correspond, and why the correspondence is, at best, partial.

WHY THEORIES OF INTELLIGENCE MATTER TO SOCIETY

Underlying every measurement of intelligence is a theory. The theory may be transparently obvious, or it may be hidden. It may be a formal explicit theory or an informal implicit one. But there is always a theory of some kind lurking beneath the test. And in the United States and some other countries, tests seem to be everywhere.

The Pervasiveness of Intelligence-Related Measurements

Students who apply to competitive independent schools in many locations and notably in New York City must present an impressive array of credentials. Among these credentials, for many of these schools, is a set of scores on either the Wechsler Preschool and Primary Scale of Intelligence III (WPPSI-R; Wechsler, 2002) or the Stanford-Binet Intelligence Scale–Fifth Edition (Roid, 2003). If the children are a bit older, they may take instead the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV; Wechsler, 2003). The lower level version of the Wechsler test is used only for children ages 3 to 7 1/2 years. The higher level version of the Wechsler test is used for somewhat older children ages 6 to 16 years, 11 months of age. The Stanford-Binet test is used across a wider range of ages, from 2 years through adult.

Children applying to independent schools in other locations are likely to take either these or similar tests. The names may be different, and the construct they are identified as measuring may differ as well: intelligence, intellectual abilities, mental abilities, scholastic aptitude, and so forth. But the tests will be highly correlated with each other, and ultimately, one will serve the schools' purposes about as well as another. These tests will be referred to as measuring *intelligence-related abilities* in order to group them together but to distinguish them from tests explicitly purported to measure intelligence.

The need to take tests such as these will not end with primary school. For admission to independent schools, in general, regardless of level, the children may take one of the Wechsler tests, the Stanford-Binet test, or some other intelligence test. More likely, they will take either the Educational Records Bureau (ERB) or the Secondary School Admissions Test (SSAT).

Independent schools are supported by fees, not tax dollars. But children attending public schools will be exposed to a similar regimen. At one time, these children would have been likely to take group intelligence (IQ) tests, which likely would have been used to track them or, at the very least, predict their futures. Today, the students are less likely to take intelligence tests, unless they are being considered for special services, such as services for educable mentally retarded (EMR) children, learning-disabled (LD) children, or gifted children. If the children wish to go to a competitive college or university, they will likely take the SAT (an acronym originally standing for Scholastic Aptitude Test, then for Scholastic Assessment Test, and now for nothing in particular) or the American College Test (ACT), the two most widely used tests used for college admissions. If individuals' scores are within the normal range of a particular college or university to which they apply for admission, the scores may not much affect their admission prospects. But if their scores are outside this range, they may be a crucial factor in determining acceptance in the case of high scores, or rejection in the case of low scores. These tests may be required whether the school is publicly or privately funded. The story still is not over.

If the individuals (now adults) wish to pursue further study, they will have to take tests of various kinds. These include the Graduate Record Examination (GRE) for graduate school, the Law School Admission Test (LSAT) for law, the Graduate Management Admission Test (GMAT) for business school, the Medical College Admission Test (MCAT) for medical school, and so forth. And the story of intelligence testing may not end with graduate-level study: Many kinds of occupational placements, especially in business, may require applicants to take intelligence tests as well.

This rather lengthy introduction to the everyday world of tests of intelligence-related abilities shows the extent to which such tests permeate U.S. society and some other contemporary societies as well. It is hard not to take such tests very seriously because they can be influential in or even determinative of a person's educational and even occupational fate.

The Societal System Created by Tests

Tests of intelligence-related skills are related to success in many cultures. People with higher test scores seem to be more successful in a variety of ways, and those with lower test scores seem to be less successful (Herrnstein & Murray, 1994; Hunt, 1995; Mackintosh, 2011a, 2011b; Urbina, 2011). Why are scores on intelligence-related tests closely related to societal success? Consider two points of view.

According to Herrnstein and Murray (1994), Wigdor and Garner (1982), and others, conventional tests of intelligence account for about 10% of the variation, on average, in various kinds of real-world outcomes. This figure increases if one makes various corrections to it (e.g., for attenuation in measures or for restriction of range in particular samples). Although this percentage is not particularly large, it is not trivial, either. Indeed, it is difficult to find any other kind of predictor that fares as well. Clearly, the tests have some value (Barnett, Rindermann, Williams, & Ceci, 2011; Gottfredson, 1986, 1997; Gottfredson & Deary, 2004; Hunt, 1995, 2011a, 2011b; Schmidt & Hunter, 1981, 1998). They predict success in many jobs and predict success even better in schooling for jobs. Rankings of jobs by prestige usually show higher prestige jobs associated with higher levels of intelligence-related skills. Theorists of intelligence differ as to why the tests have some success in prediction of job level and competency.

The Discovery of an Invisible Hand of Nature?

Some theorists believe that the role of intelligence is society is along the lines of some kind of natural law. In their book, Herrnstein and Murray (1994) refer to an "invisible hand of nature" guiding events such that people with high IQs tend to rise toward the top socioeconomic strata of a society and people with low IQs tend to fall toward the bottom strata. Jensen (1969, 1998, 2008) has made related arguments, as have many others (see, e.g., the largely unfavorable reviews by Gould, 1981; Lemann, 1999; Sacks, 1999; Zenderland, 1998). Herrnstein and Murray presented data to support their argument, although many aspects of their data and their interpretations of these data are arguable (Fraser, 1995; Gould, 1995; Jacoby & Glauberman, 1995; Sternberg, 1995).

This point of view has a certain level of plausibility to it. First, more complex jobs almost certainly do require higher levels of intelligence-related skills. Presumably, lawyers need to do more complex mental tasks than do street cleaners. Second, reaching the complex jobs via the educational system almost certainly requires a higher level of mental performance than does reaching less complex jobs. Finally, there is at least some heritable component of intelligence (Mandelman & Grigorenko, 2011; Plomin, DeFries, McClearn, & McGuffin, 2008; Plomin, DeFries, McClearn, & Rutter, 1997), so nature must play some role in who gets what mental skills. Despite this plausibility, there is an alternative point of view.

A Societal Invention?

An alternative point of view is that the sorting influence of intelligence in society is more a societal invention than a discovery of an invisible hand of nature (Sternberg, 1997, 2003). The United States and some other countries have created societies in which test scores matter profoundly. High test scores may be needed for placement in higher tracks in elementary and secondary school. They may be needed for admission to selective undergraduate programs. They may be needed again for admission to selective graduate and professional programs. Test scores help individuals gain the access routes to many of the highest paying and most prestigious jobs. Low GRE scores, for example, may exclude an individual not only from one selective graduate school, but from many others as well. To the extent that there is error of measurement, there will be comparable effects in many schools.

According to this point of view, there are many able people who may be disenfranchised because the kinds of abilities that they have are not important for test performance, even though they may be important for job performance. For example, the kinds of creative and practical skills that matter to success on the job typically are not measured on the tests used for admissions to educational programs. At the same time, society may be overvaluing those who have a fairly narrow range of skills, and a range of skills that may not serve these individuals particularly well on the job, even if they do lead to success in school and on the tests.

On this view, it is scarcely surprising that ability tests predict school grades, because the tests originally were designed explicitly for this purpose (Binet & Simon, 1905/1916). In effect, U.S. society and other societies have created closed systems: Certain abilities are valued in instruction (e.g., memory and analytical abilities). Ability tests are then created that measure these abilities and thus predict school performance. Then assessments of achievement are designed that also assess for these abilities. Little wonder that ability tests are more predictive in school than in the work place: Within the closed system of the school, a narrow range of abilities leads to success on ability tests, in instruction, and on achievement tests. But these same abilities are less important later on in life.

According to the societal-invention view, closed systems can be and have been constructed to value almost any set of attributes at all. In some societies, caste is used. Members of certain castes are allowed to rise to the top; members of other castes have no chance. Of course, the members of the successful castes believe they are getting their due, much as did members of the nobility in the Middle Ages when they rose to the top and subjugated their serfs. Even in the United States, if one were born a slave in the early 1800s, one’s IQ would make little difference: One would die a slave. Slave owners and others rationalized the system, as social Darwinists always have, by believing that the fittest were in the roles in which they rightfully belonged.

The general conclusion is that societies can and do choose a variety of criteria to sort people. Some societies have used or continue to use caste systems, whether explicit, as in India, or implicit, as in the United States. Others use or have used race, religion, or wealth of parents as bases for sorting people. Many societies use a combination of criteria. Once a system is in place, those who gain access to the power structure, whether via their passage through elite education or elsewhere, are likely to look for others like themselves to enter into positions of power. The reason, quite simply, is that there probably is no more powerful basis of interpersonal attraction than similarity, so that people in a power structure look for others similar to themselves. The result is a potentially endlessly looping closed system.

A Synthesis?

It seems fair to say that some closed systems may be better, in some sense, than are others. For example, scores on intelligence-related measures would seem more relevant to school or job performance than would social class. But it is hard to draw definitive conclusions because the various attributes that are favored by a society often tend to correlate with each other. Socialization advantages may lead people of societally preferred racial, ethnic, religious, or other groups to have higher test scores. Thus, the extent to which correlations between test scores and status attributes are natural versus manufactured is unknown because it has not been possibly to conduct a study that would look systematically and comparatively at predictors of success across societies. The closest to doing so probably comes from the work of Ogbu (1978, 1991, 1994; Ogbu & Stern, 2001), who has compared the performance of groups that in one society are of low caste but in another society are of high caste. Ogbu found that performance varies not with group but with caste: When a group is of high social caste, it performs well; when it is of low social caste, it does not.

In sum, there may be some work by an invisible hand of nature, although this hand of nature almost certainly sorts on many attributes in addition to intelligence (such as height, beauty, health, and so forth). There also may be some work through societal inventions, although societies, like nature, sort on many attributes. The role of intelligence in society needs further (and unbiased) research.

Studies of sorting use psychological tests of intelligence and intelligence-related skills. What are the psychological theories on which these tests are based? Consider first some of the classical theories and then some contemporary ones.

CLASSICAL THEORIES OF INTELLIGENCE AND THEIR CONTEMPORARY COUNTERPARTS

There are two kinds of theories that dominate thinking about intelligence, implicit and explicit theories. They will be considered in turn.

Implicit Theories

Implicit theories are people's conceptions of intelligence. Why even bother to study or report on implicit theories of intelligence? There are several reasons.

First, people's day-to-day interactions are far more likely to be affected by their implicit theories than by any explicit theories. In job interviews, admission interviews, and even daily conversations, people are continually judging each other's intelligence, based not on any formal and explicit theories but on their own implicit theories of intelligence. Second, implicit theories are of interest in their own right. Part of the study of psychology is seeking an understanding how people think, and given the importance of intelligence to society, learning how people think about intelligence is a worthy endeavor. Third, implicit theories often serve as the basis for generating explicit theories. The formal explicit theories of many psychologists (and other scientists) had their origins in these individual's implicit theories.

How have psychologists conceived of intelligence? Almost none of these views are adequately expressed by Boring's (1923) operationist view of intelligence as what intelligence tests test. For example, a symposium on experts' definitions of intelligence ("Intelligence and its measurement: A symposium," 1921) asked leading researchers how they conceptualized intelligence. Among those asked were leaders in the field such as Edward L. Thorndike, Lewis M. Terman, Lewis L. Thurstone, and Herbert Woodrow. The researchers emphasized the importance of the ability to learn and the ability to adapt to the environment. These skills seem important. Are they the skills that play a major role in explicit theories of intelligence?

Explicit Theories

We consider here the three classical theories that today have the most influence: *g* theory, the theory of primary mental abilities, and the theory of fluid and crystallized abilities.

g *Theory*

Probably the most influential theory in the history of intelligence research is the two-factor theory, which was first proposed by Spearman (1904, 1927) but has been carried forth by many modern theorists as *g* theory. Jensen (1998), himself a *g* theorist, summarizes much of this work.

Spearman (1904) noticed that tests purported to measure intelligence exhibit a *positive manifold:* They tend to correlate positively with each other. He invented a technique called *factor analysis* that was designed to analyze these intercorrelations in order to identify the purported sources of individual differences underlying the observed patterns of test scores. His factor analyses revealed two types of factors (hence the original name of his theory): the general factor (*g*), whose influence pervades all tests of mental abilities, and specific factors (*s*), whose influence is limited to a single test.

Spearman proposed two separate theories to explain the pervasive presence of *g*. One theory (Spearman, 1927) attributed the general factor to *mental energy*, a concept that he believed originated with Aristotle. The other theory was a more cognitive theory. Spearman (1923) suggested that three information-processing components (termed *qualitative principles of cognition*) were common to all of the tests. The three components were *apprehension of experience*, or encoding of stimuli; *eduction of relations*, or inferring the relation between two terms; and *eduction of correlates*, or applying the inferred relation in a new domain. In the analogy BLACK : WHITE :: HIGH : ?, for example, apprehension of experience would be used to encode the terms; eduction of relations is used to infer the relation between BLACK and WHITE; and eduction of correlates is used to apply the inferred relation from HIGH to produce LOW.

Spearman's *g* theory continues today in more modern form. Indeed, two books published in the late 1990s both were called *The* g *Factor* (Brand, 1996; Jensen, 1998). Jensen (1998, 2002) has defined *g* as a distillate of the common source of individual differences in all mental tests. He has proposed that underlying *g* are individual differences in the speed or efficiency of the neural processes that affect the kinds of behavior measured by tests of mental ability.

Jensen (1998) has built his argument in terms of converging operations that, to him, seem to indicate unequivocally the presence of some biologically based common source of variation in performance on mental tests. For example, he cited eight studies prior to 1998 using magnetic resonance imaging (MRI) that showed a correlation between IQ and brain volume (p. 147). A number of other studies have shown correlations between aspects of spontaneously measured electroencephalogram (EEG) waves and IQ and between averaged evoked potentials (AEPs) and IQ (pp. 152–157). Other studies using positron-emission tomography (PET) scanning also have shown correlations with IQ (pp. 157–159), as have studies of peripheral nerve conduction velocity (pp. 159–160) and brain-nerve conduction velocity (pp. 160–162). Some of these kinds of works are described in more detail later.

Other studies have also suggested the viability of the general factor. One example is the heritability study (see Bouchard, 1997; Jensen, 1998; Mandelman & Grigorenko, 2011; Petrill, 2002; Plomin, 1997; Plomin et al., 1997; Scarr, 1997). Such studies typically are designed to study identical twins separated at or near birth, to study identical versus fraternal twins, or to study adopted children (of known biological parentage) and biological children living in the same household. These kinds of studies enable investigators to separate, to some extent, genetic from environmental contributions to intelligence. Today it is recognized, however, that pure influences of genetics and environment are extremely difficult to disentangle (Sternberg & Grigorenko, 1997).

As mentioned earlier, the theory of general intelligence has been the longest lasting and perhaps the most widely accepted in all of the psychological literature. The evidence is impressive—certainly more so than that garnered for any competing theory. Nevertheless, the available evidence requires at least some skepticism.

First, some theorists (e.g., Davis, Christodoulou, Seider, & Gardner, 2011; Gardner, 1983, 1999, 2006; Sternberg, 1997, 1999a, 1999c, 1999d, 2003; whose work is described later) suggest that a general factor is obtained in tests of intelligence because the tests are limited to a class of fairly academic and somewhat artificial tasks. They argue that the general factor disappears or at least is greatly weakened when a broader range of tasks is used.

Second, contrary to the claim of Jensen (1998), a general factor does tend to appear as a mathematical regularity when factorial solutions are left unrotated. Such a factor tends to be produced because the methods of both common-factor and principal-components analysis in widespread use today maximize the amount of variance that they place in each successive factor, with the most possible variance going into the first factor. Thus, the first factor maximizes the loadings of variables on it.

Third, the sheer number of studies supporting a general factor does not necessarily engender support of the theory in proportion to the number of studies (Sternberg, 1999a). The large majority of these studies tends to use a somewhat restricted range of tasks, situations in which intelligence is tested, and even participants.

The Theory of Primary Mental Abilities

Thurstone (1938) proposed a theory of primary mental abilities. Although this theory is not widely used today, the theory forms the basis of many contemporary theories, including two contemporary theories discussed later, those of Gardner (1983) and Carroll (1993). It is also the basis for many contemporary group tests of intelligence, which comprise items roughly of the types described next.

Thurstone (1938) analyzed the data from 56 different tests of mental abilities and concluded that to the extent that there is a general factor of intelligence, it is unimportant and possibly epiphenomenal. From this point of view there are seven *primary mental abilities:*

1. *Verbal comprehension.* This factor involves a person's ability to understand verbal material. It is measured by tests such as vocabulary and reading comprehension.

2. *Verbal fluency.* This ability is involved in rapidly producing words, sentences, and other verbal material. It is measured by tests such as one that requires the examinee to produce as many words as possible beginning with a particular letter in a short amount of time.
3. *Number.* This ability is involved in rapid arithmetic computation and in solving simple arithmetic word problems.
4. *Perceptual speed.* This ability is involved in proofreading and in rapid recognition of letters and numbers. It is measured by tests such as those requiring the crossing out of *A*s in a long string of letters or in tests requiring recognition of which of several pictures at the right is identical to the picture at the left.
5. *Inductive reasoning.* This ability requires generalization—reasoning from the specific to the general. It is measured by tests, such as letter series, number series, and word classifications, in which the examinee must indicate which of several words does not belong with the others.
6. *Memory.* This ability is involved in remembering items, such as a list of words or numbers. Memory typically is tested through recall, whereby individuals must repeat back items stated before; through recognition, whereby individuals must state whether a given item was seen before; or via paired associates, whereby individuals must remember what items are paired with what other items.
7. *Spatial visualization.* This ability is involved in visualizing shapes, rotations of objects, and how pieces of a puzzle fit together. An example of a test would be the presentation of a geometric form followed by several other geometric forms. Each of the forms that follows the first is either the same rotated by some rigid transformation or the mirror image of the first form in rotation. The examinee has to indicate which of the forms at the right is a rotated version of the form at the left, rather than a mirror image.

Today, Thurstone's theory is not used as often in its original form, but it has served as a basis for many subsequent theories of intelligence, including hierarchical theories and modern theories such as Gardner's (1983). Thus, to the extent that a theory is judged by its heuristic value, Thurstone's theory has been one of the most important in the field.

Fluid-Crystallized Ability Theory

The theory of fluid and crystallized abilities is one of a class of hierarchical theories of intelligence (Burt, 1949; Gustafsson, 1988; Jensen, 1970; Vernon, 1971), not all of which can be described here. The theory is still current. It was proposed by Cattell (1971) but now has been proposed in a contemporary and elaborated form by Horn (1994). Only the simple form is described here.

According to this theory, *fluid ability* (Gf) is flexibility of thought and the ability to reason abstractly. It is measured by tests such as number series, abstract analogies, matrix problems, and the like. *Crystallized ability* (Gc), which is alleged to derive from fluid ability, is essentially the accumulation of knowledge and skills through the life course. It is measured by tests of vocabulary, reading comprehension, and general information. Sometimes a further distinction is made between fluid and crystallized abilities and a third ability, *visual ability* (Gv), which is the ability to manipulate representations mentally, such as those found in tests of spatial ability (as described earlier for Thurstone's theory).

A number of contemporary tests of intelligence are based on this theory. One is the Test of *g:* Culture Fair (Cattell & Cattell, 1963), which seeks to capture general ability through tests of fluid abilities. Two other such tests are the Kaufman Adolescent and Adult Intelligence Test (KAIT; Kaufman & Kaufman, 1993) and the Woodcock-Johnson Tests of Cognitive Ability–Revised (Woodcock & Johnson, 1989; see Daniel, 2000, for a review of these and other tests).

The theory of fluid and crystallized intelligence has been extremely influential in the psychological literature on intelligence. If one includes visual ability (Gv), the theory seems to capture three of the most pervasive abilities constituting intelligence. Some questions remain unresolved.

First, it is unclear whether fluid ability is statistically separable from general intelligence (Gustafsson, 1984, 1988). Such a separation appears to be difficult, and even Cattell's own allegedly culture-fair test of *g* is actually a test of fluid ability, as is the Raven's Progressive Matrices test.

Second, it is unclear whether crystallized ability really derives from or somehow springs out of fluid ability. Such a view seemed plausible when Cattell and many others could argue persuasively that tests of fluid ability were culture-fair and that fluid ability is largely unaffected by environmental factors. It now appears that both these views are erroneous. Fluid-ability tests often show greater differences between cultural groups than do crystallized ability tests; more important, they are more susceptible to the Flynn effect (considered later) than are tests of crystallized abilities. This effect refers to secular increases in scores over time. If fluid-ability scores are increasing over time more rapidly than crystallized-ability scores, one can hardly argue that they are unaffected by enculturation or, most likely, by schooling. Indeed, Ceci (1991, 1996; Ceci & Williams, 1997) has suggested that schooling has a large effect on measured intelligence of all kinds.

Third, it appears likely that there are other kinds of abilities beyond those specified by the theory of fluid and crystallized abilities. Some of the contemporary theories considered next attempt to specify what these abilities might be.

Implicit Theories

Expert Views

Sixty-five years after the symposium in the *Journal of Educational Psychology* on intelligence, Sternberg and Detterman (1986) conducted a similar symposium, again asking experts about their views on intelligence. Experts such as Earl Butterfield, Douglas Detterman, Earl Hunt, Arther Jensen, and Robert Sternberg gave their views. Learning and adaptive abilities retained their importance, and a new emphasis crept in—metacognition, or the ability to understand and control one's self. Of course, the name is new, but the idea is not, because long ago Aristotle emphasized the importance for intelligence of knowing oneself.

The 1921 and 1986 symposia could be criticized for being overly Western in the composition of their contributors. In some cases, Western notions about intelligence are not shared by other cultures. For example, the Western emphasis on speed of mental processing (Sternberg, Conway, Ketron, & Bernstein, 1981) is absent in many cultures. Other cultures may even be suspicious of the quality of work that is done very quickly. Indeed, other cultures emphasize depth rather than speed of processing. They are not alone: Some prominent Western theorists have pointed out the importance of depth of processing for full command of material (e.g., Craik & Lockhart, 1972). Even L. L. Thurstone (1924) emphasized the importance to human intelligence of withholding a quick, instinctive response, a view that Stenhouse (1973) argued is supported by evolutionary theory. Today, unlike in the past, psychologists have a better idea of the implicit theories of people in diverse cultures.

Laypersons' Views (Across Cultures)

Yang and Sternberg (1997a) reviewed Chinese philosophical conceptions of intelligence. The Confucian perspective emphasizes the characteristic of benevolence and of doing what is right. As in the Western notion, the intelligent person spends much effort in learning, enjoys learning, and persists in lifelong learning with a great deal of enthusiasm. The Taoist tradition, in contrast, emphasizes the importance of humility, freedom from conventional standards of judgment, and full knowledge of oneself as well as of external conditions.

The difference between Eastern and Western conceptions of intelligence may persist even in the present day. Yang and Sternberg (1997b) studied contemporary Taiwanese Chinese conceptions of intelligence and found five factors underlying these conceptions: (1) a general cognitive factor, much like the *g* factor in conventional Western tests; (2) interpersonal intelligence; (3) intrapersonal intelligence; (4) intellectual self-assertion; and (5) intellectual self-effacement. In a related study but with different results, Chen (1994) found three factors underlying Chinese conceptualizations of intelligence: (1) nonverbal reasoning ability, (2) verbal reasoning ability, and (3) rote memory. The difference may be due to different subpopulations of Chinese, to differences in methodology, or to differences in when the studies were done.

The factors uncovered in both studies differ substantially from those identified in U.S. people's conceptions of intelligence by Sternberg et al. (1981). The factors uncovered by this study were (a) practical problem solving, (b) verbal ability, and (c) social competence, although in both cases people's implicit theories of intelligence seem to go far beyond what conventional psychometric intelligence tests measure. Of course, comparing the Chen (1994) to the Sternberg et al. study simultaneously varies both language and culture.

M. Chen and Chen (1988) varied only language. They explicitly compared the concepts of intelligence of Chinese graduates from Chinese-language versus English-language schools in Hong Kong. They found that both groups considered nonverbal reasoning skills as the most relevant skill for measuring intelligence. Verbal reasoning and social skills came next, and then numerical skill. Memory was seen as least important. The Chinese-language group, however, tended to rate verbal skills as less important than did the English-language group. Moreover, in an earlier study, Chen, Braithwaite, and Huang (1982) found that Chinese students viewed memory for facts as important for intelligence, whereas Australian students viewed these skills as being of only trivial importance.

Das (1994), also reviewing Eastern notions of intelligence, has suggested that in Buddhist and Hindu philosophies, intelligence involves waking up, noticing, recognizing, understanding, and comprehending, but also includes such things as determination, mental effort, and even feelings and opinions in addition to more intellectual elements.

Differences between cultures in conceptions of intelligence have been recognized for some time. Gill and Keats (1980) noted that Australian university students value academic skills and the ability to adapt to new events as critical to intelligence, whereas Malay students value practical skills, as well as speed and creativity. Dasen (1984) found Malay students to emphasize both social and cognitive attributes in their conceptions of intelligence.

The differences between East and West may be due to differences in the kinds of skills valued by the two kinds of cultures (Srivastava & Misra, 1996). Western cultures and their schools emphasize what might be called *technological intelligence* (Mundy-Castle, 1974), so things like artificial intelligence and so-called smart bombs are viewed, in some sense, as intelligent, or smart.

Western schooling emphasizes other things as well (Srivastava & Misra, 1996), such as generalization, or going beyond the information given (Connolly & Bruner, 1974; Goodnow, 1976), speed (Sternberg, 1985), minimal moves to a solution (Newell & Simon, 1972), and creative thinking (Goodnow). Moreover, silence is interpreted as a lack of knowledge (Irvine, 1978). In contrast, the Wolof tribe in Africa views people of higher social class and distinction as speaking less (Irvine). This difference between the Wolof and Western notions suggests the usefulness of looking at African notions of intelligence as a possible contrast to U.S. notions.

In fact, studies in Africa provide yet another window on the substantial differences. Ruzgis and Grigorenko (1994) have argued that, in Africa, conceptions of intelligence revolve largely around skills that help to facilitate and maintain harmonious and stable intergroup relations; intragroup relations are probably equally important and at times more important. For example, Serpell (1974, 1982, 1993) found that Chewa adults in Zambia emphasize social responsibilities, cooperativeness, and obedience as important to intelligence; intelligent children are expected to be respectful of adults. Kenyan parents also emphasize responsible participation in family and social life as important aspects of intelligence (Super, 1983; Super & Harkness, 1982). In Zimbabwe, the word for intelligence, *ngware*, actually means to be prudent and cautious, particularly in social relationships. Among the Baoule, service to the family and community and politeness toward and respect for elders are seen as key to intelligence (Dasen, 1984).

Similar emphasis on social aspects of intelligence has been found as well among two other African groups, the Songhay of Mali and the Samia of Kenya (Putnam & Kilbride, 1980). The Yoruba, another African tribe, emphasize the importance of depth—of listening rather than just talking—to intelligence, and of being able to see all aspects of an issue and of being able to place the issue in its proper overall context (Durojaiye, 1993).

The emphasis on the social aspects of intelligence is not limited to African cultures. Notions of intelligence in many Asian cultures also emphasize the social aspect of intelligence more than does the conventional Western or IQ-based notion (Azuma & Kashiwagi, 1987; Lutz, 1985; Poole, 1985; White, 1985).

It should be noted that neither African nor Asian cultures emphasize exclusively social notions of intelligence. In one village in Kenya (near Kisumu), many and probably most of the children are at least moderately infected with a variety of parasitic infections. As a result, they experience stomachaches quite frequently. Traditional medicine suggests the usefulness of a large variety (actually, hundreds) of natural herbal medicines that can be used to treat such infections. It appears that at least some of these—although perhaps a small percentage—actually work. More important for our purposes, however, children who learn how to self-medicate via these natural herbal medicines are viewed as being at an adaptive advantage over those who do not have this kind of informal knowledge. Clearly, the kind of adaptive advantage that is relevant in this culture would be viewed as totally irrelevant in the West, and vice versa.

Grigorenko and her colleagues (2001) have studied conceptions of intelligence in this village in some detail. There appear to be four parts to the conception.

First, the concept of *rieko* can be translated as intelligence, smartness, knowledge, ability, skill, competence, and power. Along with the general concept of *rieko*, the Luo people distinguish among various specialized representations of this concept. Some representations are characterized by the source of *rieko: rieko mar sikul* (knowledge acquired in school), or *rieko mzungu* (the White man's technical powers); others by different domains of action: *rieko mar ot* (competence in household tasks, including planning skills and resource management), or *rieko mar kite* (being versed in traditional customs and rules). Other representations are characterized by specific outcomes, such as *rieko mar lupo* (fishing skills, including knowledge of magic to provide rich catches), *rieko mar yath* (knowledge of healing with herbal medicines), and so forth.

Luoro is the second main quality of children and people in general. It encompasses a whole field of concepts roughly corresponding to social qualities such as respect and care for others, obedience, diligence, consideration, and readiness to share. *Luoro* has an unequivocal positive meaning and was always mentioned as a necessity in response to questions such as “What is most important for a good child to have?” and “What should people have to lead a happy life?” When people were asked to compare the relative importance for an individual’s life of *rieko* and *luoro,* respondents generally gave preference to *luoro.* It is interesting that the only two respondents ranking *rieko* higher than *luoro* were outsiders to the local community who had a tertiary education and considerable wealth by village standards. *Rieko* and *luoro* are complementary. *Rieko* is a positive attribute only if *luoro* is also present. Ideally, the power of pure individual abilities should be kept under control by social rules.

Third, *paro* overlaps with both *luoro* and *rieko* and, roughly translated, means *thinking.* Specifically, *paro* refers to the thought processes required to identify a problem and its solution and to the thought processes involved in caring for other people. A child with good thinking (*paro maber*) could thus, for example, be a child who is able to react rationally in case of another person’s accident or one who is able to collect wood, burn charcoal, and sell it favorably in order to help his old grandmother. The concept of *paro* stresses the procedural nature of intelligence. In essence, *paro* occupies an intermediate position between the potentiality of *rieko* (its ability aspects) and the partially moral connotation of an outcome (the deed) done with or without *luoro. Paro* also reflects the idea of initiative and innovation, for example, in designing a new technical device. *Paro* encompasses the process of thinking, the ability to think, and the specific kind of thinking that an individual demonstrates.

Fourth, *winjo,* like *paro,* is linked to both *rieko* and *luoro. Winjo* means comprehending and understanding. It points to the child’s abilities to comprehend, that is, to process what is said or what is going on. But it also involves the ability to grasp what is appropriate and inappropriate in a situation, that is, to understand and do what you are told by adults or to derive from the situation what is appropriate to do. It shares with the other key terms the feature that its meaning is a function of context. For a teacher in school it means that a child runs an errand as told. In contrast, a grandmother teaching a child about healing might emphasize the aspect of procedural learning combined with attention to another person.

A “good child” as well as a “good community member” needs a balanced mixture of all positive qualities, in which the contradictory aspects counterbalance each other. Specifically, the ambiguous powers of individual *rieko* (which could be either positive or negative) need to be controlled by social values and rules (*luoro*).

These conceptions of intelligence emphasize social skills much more than do conventional U.S. conceptions of intelligence, but at the same time they recognize the importance of cognitive aspects of intelligence. It is important to realize, again, that there is no one overall U.S. conception of intelligence. Indeed, Okagaki and Sternberg (1993) found that different ethnic groups in San Jose, California, had rather different conceptions of what it means to be intelligent. For example, Latino parents of schoolchildren tended to emphasize the importance of social-competence skills in their conceptions of intelligence, whereas Asian parents tended rather heavily to emphasize the importance of cognitive skills. Anglo parents also emphasized cognitive skills more. Teachers, representing the dominant culture, emphasized cognitive skills more than social-competence skills. The rank order of children of various groups’ performances (including subgroups within the Latino and Asian groups) could be perfectly predicted by the extent to which parents shared the teachers’ conceptions of intelligence. In other words, teachers tended to reward those children who were socialized into a view of intelligence that happened to correspond to the teachers’ own.

Explicit Theories

A Psychometric Theory

The psychometric approach to intelligence is among the oldest of approaches, dating back to Galton’s (1883) psychophysical theory of intelligence in terms of psychophysical abilities (such as strength of hand grip or visual acuity) and later to Binet and Simon’s (1905/1916) theory of intelligence as judgment, involving adaptation to the environment, direction of one’s efforts, and self-criticism.

Carroll (1993) has proposed a hierarchical model of intelligence, based on a factor analysis of more than 460 datasets obtained between 1927 and 1987. His analysis encompasses more than 130,000 people from diverse walks of life and even countries of origin (although non-English-speaking countries are poorly represented among his datasets). The model Carroll proposed, based on his monumental undertaking, is a hierarchy comprising three strata: Stratum I, which includes many narrow, specific abilities (e.g., spelling ability, speed of reasoning); Stratum II, which includes various group-factor abilities (e.g., fluid intelligence, involved in flexible thinking and seeing things in novel ways; and crystallized intelligence, the accumulated knowledge base); and Stratum III, which is just a single general intelligence, much like Spearman's (1904) general intelligence factor.

Of these strata, the most interesting is perhaps the middle stratum, which includes (in addition to fluid and crystallized abilities) learning and memory processes, visual perception, auditory perception, facile production of ideas (similar to verbal fluency), and speed (which includes both sheer speed of response and speed of accurate responding). Although Carroll does not break much new ground, in that many of the abilities in his model have been mentioned in other theories, he does masterfully integrate a large and diverse factor-analytic literature, thereby giving great authority to his model. At the same time, his meta-analysis assumes that conventional psychometric tests cover the entire domain of intelligence that needs to be covered by a theory of intelligence. Some theorists, discussed next, question this assumption.

Cognitive Theories

Cronbach (1957) called for a merging of the two disciplines of scientific psychology: the differential and experimental approaches. The idea is that the study of individual differences (differential psychology) and of cross-individual commonalities (experimental psychology) need not be separate disciplines. They can be merged.

Serious responses to Cronbach came in the 1970s, with cognitive approaches to intelligence attempting this merger. Two of the responses were the cognitive-correlates approach to intelligence and the cognitive-correlates approach.

Hunt, Frost, and Lunneborg (1973; see also Hunt, Lunneborg, & Lewis, 1975) introduced the cognitive-correlates approach, whereby scores on laboratory cognitive tests were correlated with scores on psychometric intelligence tests. The theory underlying this work was that fairly simple components of information processing studied in the laboratory—such as the time to retrieve lexical information from long-term memory—could serve as a basis for understanding human intelligence. Intelligence tests, on this view, present complex problems whose solution nevertheless relies on fairly simple information processing. Thus, a participant in a cognitive study might be asked whether two letters, *A* and *a*, are identical in identity (answer: yes) or identical in case (answer: no). The tasks were directly out of the literature of experimental psychology, including the letter-comparison task, which is based on work by Posner and Mitchell (1967).

Sternberg (1977; see also Sternberg, 1983) introduced the cognitive-components approach, whereby performance on complex psychometric tasks was decomposed into elementary information-processing components. The underlying theory was that intelligence comprises a series of component information processes. In contrast to the cognitive-correlates approach, however, the underlying components were seen as complex rather than as simple. For example, solving an analogy of the form A : B :: C : ? involves components such as encoding the terms, inferring the relation between A and B, applying this relation from C to ?, and so forth (see reviews by Lohman, 2000; Lohman & Lakin, 2011).

The cognitive approaches of Hunt and Sternberg are now primarily of historical interest. Both authors have expanded their conceptualizations of intelligence since this work. They were forced to do so. Neither approach yielded consistently high correlations between the tasks and task components and psychometric tests of intelligence used as criteria. Moreover, sometimes the components showing the highest correlations were the ones least expected to show them. Sternberg and Gardner (1983), for example, consistently found the regression-constant component to have the highest correlations with psychometric test scores, leading them to wonder whether they had rediscovered through information-processing analysis the general factor that had been discovered through psychometric analysis.

In the 1990s, cognitive and biological approaches (discussed next) began to merge (Vernon, Wickett, Bazana, & Stelmack, 2000). A prototypical example is the inspection-time task (Nettlebeck, 1982; see reviews by Deary, 2000; Deary & Stough, 1996: Nettlebeck, 2011). In this task, two adjacent vertical lines are presented tachistoscopically or by computer, followed by a visual mask (to destroy the image in visual iconic memory). The two lines differ in length, as do the lengths of time for which the two lines are presented. The participant's task is to say which line is longer. But instead of using raw response time as the dependent variable, investigators typically use measures derived from a psychophysical function estimated after many trials. For example, the measure might be the duration of a single inspection trial at which 50% accuracy is achieved. Correlations between this task and measures of IQ appear to be about .4, a bit higher than is typical in psychometric tasks. Much of this correlation may be mediated by the visual ability component of intelligence (Gv). There are differing theories as to why such correlations are obtained. All such theories generally attempt to relate the cognitive function of visual inspection time to some kind of biological function, such as speed of neuronal conduction. Let us consider, then, some of the biological functions that may underlie intelligence.

Biological Theories

An important approach to studying intelligence is to understand it in terms of the functioning of the brain, in particular, and of the nervous system, in general. Earlier theories relating the brain to intelligence tended to be global in nature, although they were not necessarily backed by strong empirical evidence. Because these earlier theories are still used in contemporary writings and, in the case of Halstead and Luria, form the bases for test batteries still in contemporary use, they are described here briefly.

Early Biological Theories. Halstead (1951) suggested that there are four biologically based abilities, which he called (1) the integrative field factor, (2) the abstraction factor, (3) the power factor, and (4) the directional factor. Halstead attributed all four of these abilities primarily to the functioning of the cortex of the frontal lobes. More influential than Halstead has been Hebb (1949), who distinguished between two basic types of intelligence: Intelligence A and Intelligence B. Hebb's distinction is still used by some theorists. According to Hebb, Intelligence A is innate potential, and Intelligence B is the functioning of the brain as a result of the actual development that has occurred. These two basic types of intelligence should be distinguished from Intelligence C, or intelligence as measured by conventional psychometric tests of intelligence. Hebb also suggested that learning, an important basis of intelligence, is built up through cell assemblies, by which successively more and more complex connections among neurons are constructed as learning takes place. A third biological based theory is that of Luria (1973, 1980), which has had a major impact on tests of intelligence (A. Kaufman & Kaufman, 1983; Naglieri & Das, 1997). According to Luria, the brain comprises three main units with respect to intelligence: (1) a unit of arousal in the brain stem and midbrain structures; (2) a senior input unit in the temporal, parietal, and occipital lobes; and (3) an organization and planning unit in the frontal cortext. The more modern form of this theory is PASS theory (Das, Kirby, & Jarman, 1979; Naglieri & Das, 1990, 1997, 2002), which distinguishes among planning, attentional, successive processing, and simultaneous processing abilities. These latter two abilities are subsets of the sensory-input abilities referred to by Luria. The early biological theories continue to have an influence on theories of intelligence. Oddly, their influence on contemporary psychometric work is substantially greater than their influence on contemporary biological work, which largely (although not wholly) has left these theories behind.

Contemporary Biological Theories. More recent theories have dealt with more specific aspects of brain or neural functioning. One contemporary biological theory is based on *speed of neuronal conduction.* For example, one theory has suggested that individual differences in nerve-conduction velocity are a basis for individual differences in intelligence (e.g., Reed & Jensen, 1992; Vernon & Mori, 1992). Two procedures have been used to measure conduction velocity, either centrally (in the brain) or peripherally (e.g., in the arm). Reed and Jensen (1992) tested brain-nerve conduction velocities via two medium-latency potentials, N70 and P100, which were evoked by pattern-reversal stimulation. Subjects saw a black-and-white checkerboard pattern in which the black squares would change to white and the white squares to black. Over many trials, responses to these changes were analyzed via electrodes attached to the scalp in four places. Correlations of derived latency measures with IQ were small (generally in the .1 to .2 range of absolute value), but were significant in some cases, suggesting at least a modest relation between the two kinds of measures. Vernon and Mori (1992) reported on two studies investigating the relation between nerve-conduction velocity in the arm and IQ. In both studies nerve-conduction velocity was measured in the median nerve of the arm by attaching electrodes to the arm. In the second study, conduction velocity from the wrist to the tip of the finger was also measured. Vernon and Mori found significant correlations with IQ in the .4 range, as well as somewhat smaller correlations (around .2) with response-time measures. They interpreted their results as supporting the hypothesis of a relation between speed of information transmission in the peripheral nerves and intelligence. However, these results must be interpreted cautiously, as Wickett and Vernon (1994) later tried unsuccessfully to replicate these earlier results. Other work has emphasized P300 as a measure of intelligence. Higher amplitudes of P300 are suggestive of higher levels of extraction of information from stimuli (Johnson, 1986, 1988) and also more rapid adjustment to novelty in larger left hemisphere better predicted WAIS-R verbal than it predicted nonverbal ability, whereas in women a larger left hemisphere better predicted WAIS-R verbal than it predicted nonverbal ability, whereas in women a larger left hemisphere predicted nonverbal ability better than it predicted verbal ability (Willerman, Schultz, Rutledge, & Bigler, 1992). These brain-size correlations are suggestive, but it is difficult to say what they mean at this point.

Yet another approach that is at least partially biologically based is that of behavior genetics. A fairly complete review of this extensive literature is found in Sternberg and Grigorenko (1997). The basic idea is that it should be possible to disentangle genetic from environmental sources of variation in intelligence. Ultimately, one would hope to locate the genes responsible for intelligence (Plomin, McClearn, & Smith, 1994, 1995; Plomin & Neiderhiser, 1992; Plomin & Petrill, 1997). The literature is complex, but it appears that about half the total variance in IQ scores is accounted for by genetic factors (Loehlin, 1989; Plomin, 1997). This figure may be an underestimate because the variance includes error variance and because most studies of heritability have been with children, but we know that heritability of IQ is higher for adults than for children (Plomin, 1997). Also, some studies, such as the Texas Adoption Project (Loehlin, Horn, & Willerman, 1997), suggest higher estimates: .78 in the Texas Adoption Project, .75 in the Minnesota Study of Twins Reared Apart (Bouchard, 1997; Bouchard, Lykken, McGue, Segal, & Tellegen, 1990), and .78 in the Swedish Adoption Study of Aging (Pedersen, Plomin, Nesselroade, & McClearn, 1992).

At the same time, some researchers argue that effects of heredity and environment cannot be clearly and validly separated (Bronfenbrenner & Ceci, 1994; Wahlsten & Gottlieb, 1997). Perhaps, the direction of future research should be to figure out how heredity and environment work together to produce phenotypic intelligence (Scarr, 1997), concentrating especially on within-family environmental variation, which appears to be more important than between-family variation (Jensen, 1997). Such research requires, at the very least, carefully prepared tests of intelligence, perhaps some of the newer tests described in the next section.

Systems Theories

Many contemporary theories of intelligence can be viewed as systems theories because they are more complex, in many respects, than past theories, and attempt to deal with intelligence as a complex system.

The Theory of Multiple Intelligences. Gardner (1983, 1993, 1999) proposed that there is no single, unified intelligence, but rather a set of relatively distinct, independent, and modular multiple intelligences. His theory of multiple intelligences (MI theory) originally proposed seven multiple intelligences: (1) linguistic, as used in reading a book or writing a poem; (2) logical-mathematical, as used in deriving a logical proof or solving a mathematical problem; (3) spatial, as used in fitting suitcases into the trunk of a car; (4) musical, as used in singing a song or composing a symphony; (5) bodily-kinesthetic, as used in dancing or playing football; (6) interpersonal, as used in understanding and interacting with other people; and (7) intrapersonal, as used in understanding oneself.

Recently, Gardner (1999) has proposed an additional intelligence as a confirmed part of his theory: naturalist intelligence, the kind shown by people who are able to discern patterns in nature. Charles Darwin would be a notable example. Gardner has also suggested that there may be two other intelligences: spiritual intelligence and existential intelligence. Spiritual intelligence involves a concern with cosmic or existential issues and the recognition of the spiritual as the achievement of a state of being. Existential intelligence involves a concern with ultimate issues. Gardner believes that the evidence for these latter two intelligences is less powerful than the evidence for the other eight intelligences. Whatever the evidence may be for the other eight, we agree that the evidence for these two new intelligences is speculative at this point.

Most activities will involve some combination of these different intelligences. For example, dancing might involve both musical and bodily-kinesthetic intelligences. Reading a mathematical textbook might require both linguistic and logical-mathematical intelligences. Often it will be hard to separate these intelligences in task performance.

In the past, factor analysis served as the major criterion for identifying abilities. Gardner (1983, 1999) proposed a new set of criteria, including but not limited to factor analysis, for identifying the existence of a discrete kind of intelligence: (a) potential isolation by brain damage, in that the destruction or sparing of a discrete area of the brain may destroy or spare a particular kind of intelligent behavior; (b) the existence of exceptional individuals who demonstrate extraordinary ability (or deficit) in a particular kind of intelligent behavior; (c) an identifiable core operation or set of operations that are essential to performance of a particular kind of intelligent behavior; (d) a distinctive developmental history leading from novice to master, along with disparate levels of expert performance; (e) a distinctive evolutionary history, in which increases in intelligence may be plausibly associated with enhanced adaptation to the environment; (f) supportive evidence from cognitive-experimental research; (g) supportive evidence from psychometric tests; and (h) susceptibility to encoding in a symbol system.

Gardner (1993, 1995, 1997) has suggested that the multiple intelligences can be understood as bases not only for understanding intelligence, but for understanding other kinds of constructs as well, such as creativity and leadership. For example, Gardner has analyzed some of the great creative thinkers of the 20th century in terms of their multiple intelligences, arguing that many of them were extraordinarily creative by virtue of extremely high levels of one of the intelligences. For example, Martha Graham was very high in bodily-kinesthetic intelligence, T. S. Eliot in linguistic intelligence, and so forth.

The theory of multiple intelligences has proved to be enormously successful in capturing the attention both of the psychological public and of the public in general. Nevertheless, some caution must be observed before accepting the theory.

First, since the theory was proposed in 1983, there have been no published empirical tests of the theory as a whole. Given that a major goal of science is empirically to test theories, this fact is something of a disappointment, but it certainly suggests the need for such testing.

Second, the theory has been justified by Gardner on the basis of post hoc reviews of various literatures. Although these reviews are persuasive, they are also highly selective. For example, there is virtually no overlap between the literatures reviewed by Gardner in his various books and the literatures reviewed by Carroll (1993) or Jensen (1998). This is not to say that his literature is wrong or that theirs is right. Rather, all literature reviews are selective and probably tend more to dwell on studies that support the proposed point of view. A difference between the literature reviewed by Gardner and that reviewed by Carroll and Jensen is that the literature Gardner reviews was not intended to test his theory of intelligence or anything like it. In contrast, the literatures reviewed by Carroll and Jensen largely comprise studies designed specifically to test psychometric theories of intelligence.

Third, even if one accepts Gardner's criteria for defining an intelligence, it is not clear whether the 8 or 10 intelligences proposed by Gardner are the only ones that would fit. For example, might there be a sexual intelligence? And are these intelligences really *intelligences*, per se, or are some of them better labeled *talents?* Obviously, the answer to this question is definitional, and hence there may be no ultimate answer at all.

Finally, there is a real need for psychometrically strong assessments of the various intelligences, because without such assessments it will be difficult ever to validate the theory.

Assessments exist (Gardner, Feldman, & Krechevsky, 1998), but they seem not to be psychometrically strong. Without strong assessments, the theory is likely to survive without or because of the lack of serious attempts at disconfirmation.

Since the theory was first proposed, a large number of educational interventions have arisen that are based on the theory, sometimes closely and other times less so (Gardner, 1993). Many of the programs are unevaluated, and evaluations of other programs seem still to be ongoing, so it is difficult to say at this point what the results will be. In one particularly careful evaluation of a well-conceived program in a large southern city, there were no significant gains in student achievement or changes in student self-concept as a result of an intervention program based on Gardner's (1983, 1999) theory (Callahan, Tomlinson, & Plucker, 1997). There is no way of knowing whether these results are representative of such intervention programs, however.

Successful Intelligence. Sternberg (1997, 1999c, 1999d) has suggested that we may wish to pay less attention to conventional notions of intelligence and more to what he terms *successful intelligence*, or the ability to adapt to, shape, and select environments to accomplish one's goals and those of one's society and culture. A successfully intelligent person balances adaptation, shaping, and selection, doing each as necessary. The theory is motivated in part by repeated findings that conventional tests of intelligence and related tests do not predict meaningful criteria of success as well as they predict scores on other similar tests and school grades (e.g., Sternberg & Williams, 1997).

Successful intelligence involves an individual's discerning his or her pattern of strengths and weaknesses and then figuring out ways to capitalize on the strengths and at the same time compensate for or correct the weaknesses. People attain success, in part, in idiosyncratic ways that involve their finding how best to exploit their own patterns of strengths and weaknesses.

According to the proposed theory of human intelligence and its development (Sternberg, 1980, 1984, 1985, 1990, 1997, 1999a, 1999b), a common set of processes underlies all aspects of intelligence. These processes are hypothesized to be universal. For example, although the solutions to problems that are considered intelligent in one culture may be different from the solutions considered to be intelligent in another culture, the need to define problems and translate strategies to solve these problems exists in any culture.

Metacomponents, or executive processes, plan what to do, monitor things as they are being done, and evaluate things after they are done. Examples of metacomponents are recognizing the existence of a problem, defining the nature of the problem, deciding on a strategy for solving the problem, monitoring the solution of the problem, and evaluating the solution after the problem is solved.

Performance components execute the instructions of the metacomponents. For example, inference is used to decide how two stimuli are related, and application is used to apply what one has inferred (Sternberg, 1977). Other examples of performance components are comparison of stimuli, justification of a given response as adequate although not ideal, and actually making the response.

Knowledge-acquisition components are used to learn how to solve problems or simply to acquire declarative knowledge in the first place (Sternberg, 1985). Selective encoding is used to decide what information is relevant in the context of one's learning. Selective comparison is used to bring old information to bear on new problems. Selective combination is used to put together the selectively encoded and compared information into a single and sometimes insightful solution to a problem.

Although the same processes are used for all three aspects of intelligence universally, these processes are applied to different kinds of tasks and situations depending on whether a given problem requires analytical thinking, creative thinking, practical thinking, or a combination of these kinds of thinking. Data supporting the theory cannot be presented fully here but are summarized elsewhere (Sternberg, 1977, 1985; Sternberg et al., 2000).

Three broad abilities are important to successful intelligence: analytical, creative, and practical abilities.

Analytical abilities are required to analyze and evaluate the options available to oneself in life. They include things such as identifying the existence of a problem, defining the nature of the problem, setting up a strategy for solving the problem, and monitoring one's solution processes.

Creative abilities are required to generate problem-solving options in the first place. Creative individuals typically "buy low and sell high" in the world of ideas (Sternberg & Lubart, 1995, 1996): They are willing to generate ideas that, like stocks with low price-earnings ratios, are unpopular and perhaps even deprecated. Having convinced at least some people of the value of these ideas, they then sell high, meaning that they move on to the next unpopular idea. Research shows that these abilities are at least partially distinct from conventional IQ and that they are moderately domain specific, meaning that creativity in one domain (such as art) does not necessarily imply creativity in another (such as writing; Sternberg & Lubart, 1995). Not all creative work is crowd defying, of course. Some work is creative by virtue of extending existing paradigms (see Sternberg, 1999b).

Practical abilities are required to implement options and to make them work. Practical abilities are involved when intelligence is applied to real-world contexts. A key aspect of practical intelligence is the acquisition and use of tacit knowledge, which is knowledge of what one needs to know to succeed in a given environment that is not explicitly taught and that usually is not verbalized. Research shows several generalizations about tacit knowledge. First, it is acquired through mindful utilization of experience. What matters, however, is not the experience, per se, but how much one profits from it. Second, tacit knowledge is relatively domain specific, although people who are likely to acquire it in one domain are likely to acquire it in another domain. Third, acquisition and utilization are relatively independent of conventional abilities. Fourth, tacit knowledge predicts criteria of job success about as well as and sometimes better than does IQ. Fifth, tacit knowledge predicts these criteria incrementally over IQ and other kinds of measures, such as of personality and of styles of learning and thinking (McClelland, 1973; Sternberg et al., 2000; Sternberg & Wagner, 1993; Sternberg, Wagner, Williams, & Horvath, 1995).

The separation of practical intelligence from IQ has been shown in a number of different ways in a number of different studies (see Sternberg et al., 2000, for a review). Scribner (1984, 1986) showed that experienced assemblers in a milk-processing plant used complex strategies for combining partially filled cases in a manner that minimized the number of moves required to complete an order. Although the assemblers were the least educated workers in the plant, they were able to calculate in their heads quantities expressed in different base number systems, and they routinely outperformed the more highly educated white-collar workers who substituted when the assemblers were absent. Scribner found that the order-filling performance of the assemblers was unrelated to measures of academic skills, including intelligence test scores, arithmetic test scores, and grades.

Ceci and Liker (1986) carried out a study of expert racetrack handicappers and found that expert handicappers used a highly complex algorithm for predicting post time odds that involved interactions among seven kinds of information. Use of a complex interaction term in their implicit equation was unrelated to the handicappers' IQs.

A series of studies showed that shoppers in California grocery stores were able to choose which of several products represented the best buy for them (Lave, Murtaugh, & de la Roche, 1984; Murtaugh, 1985). They were able to do so even though they did very poorly on the same kinds of problems when the problems were presented in the form of a paper-and-pencil arithmetic computation test. The same principle that applies to adults appears to apply to children as well: Carraher, Carraher, and Schliemann (1985) found that Brazilian street children who could apply sophisticated mathematical strategies in their street vending were unable to do the same in a classroom setting (see also Ceci & Roazzi, 1994; Nuñes, 1994).

One more example of a study of practical intelligence was provided by individuals asked to play the role of city managers for the computer-simulated city of Lohhausen (Dörner & Kreuzig, 1983; Dörner, Kreuzig, Reither, & Staudel, 1983). A variety of problems were presented to these individuals, such as how best to raise revenue to build roads. The simulation involved more than 1,000 variables. No relation was found between IQ and complexity of strategies used.

There is also evidence that practical intelligence can be taught (Gardner, Krechevsky, Sternberg, & Okagaki, 1994; Sternberg, Okagaki, & Jackson, 1990), at least in some degree. For example, middle-school children given a program for developing their practical intelligence for school (strategies for effective reading, writing, execution of homework, and taking of tests) improved more from pretest to posttest than did control students who received an alternative but irrelevant treatment.

None of these studies suggest that IQ is unimportant for school or job performance or other kinds of performance; indeed, the evidence suggests the contrary (Barrett & Depinet, 1991; Gottfredson, 1986, 1997; Hunt, 1995; Hunter & Hunter, 1984; Schmidt & Hunter, 1981, 1993, 1998; Wigdor & Garner, 1982). What the studies do suggest, however, is that there are other aspects of intelligence that are relatively independent of IQ, and that are important as well. A multiple-abilities prediction model of school or job performance would probably be most satisfactory.

According to the theory of successful intelligence, children's multiple abilities are underutilized in educational institutions because teaching tends to value analytical (as well as memory) abilities at the expense of creative and practical abilities. Sternberg, Ferrari, Clinkenbeard, and Grigorenko (1996; Sternberg, Grigorenko, Ferrari, & Clinkenbeard, 1999) designed an experiment in order to illustrate this point. They identified 199 high school students from around the United States who were strong in either analytical, creative, or practical abilities, or all three kinds of abilities, or none of the kinds of abilities. Students were then brought to Yale University to take a college-level psychology course that was taught in a way that emphasized memory, analytical, creative, or practical abilities. Some students were matched, and others mismatched, to their own strengths. All students were evaluated for memory-based, analytical, creative, and practical achievements.

Sternberg and his colleagues found that students whose instruction matched their pattern of abilities performed significantly better than did students who were mismatched. They also found that prediction of course performance was improved by taking into account creative and practical as well as analytical abilities.

In subsequent studies (Grigorenko, Jarvin, & Sternberg, 2002; Sternberg, Torff, & Grigorenko, 1998), students were taught a subject matter in a variety of ways in order to compare instruction based on the theory of successful intelligence with other forms of instruction. For example, one set of studies compared such instruction with instruction based on critical thinking and instruction based on traditional, memory-based learning in social studies and science (Sternberg et al., 1998). Another study compared instruction based on successful intelligence to traditional instruction in reading (Grigorenko et al., 2002). Participants in these experiments ranged from middle-school to high-school levels and covered the range of socioeconomic levels from very low to very high. In general, instruction based on the theory of successful intelligence was superior to the other forms of instruction, even if tests of achievement measured only memory-based learning.

At a theoretical level, why should instruction based on the theory of successful intelligence be more effective than conventional or other forms of instruction? Five reasons have been proffered. First, instruction based on the theory of successful intelligence encourages students to capitalize on strengths. Second, it encourages them to correct or to compensate for weaknesses. Third, it enables them to encode material in three different ways, which, by increasing the number of retrieval routes to the information, facilitates memory retrieval later on. Fourth, it encourages elaborative rather than maintenance rehearsal, which results in more elaborated memory traces for the material. Fifth, it is more motivating to students because it typically renders the material more interesting than do conventional forms of presentation.

The theory of successful intelligence has been tested more extensively than many other contemporary theories of intelligence. Nevertheless, questions remain. For example, even some who might accept the existence of distinctive creative and practical abilities might argue that they represent psychological attributes distinct from intelligence. Second, the pervasiveness of the general factor in psychological investigations must make one wary of Type I errors in accepting the notion that the general factor is not truly general, but rather applies primarily to academic kinds of tasks. Third, there is as yet no published test that measures the triarchic abilities, and the research-based tests clearly need further development. Without published tests, it will be difficult for laboratories other than those of the principal proponents of the theory to test the theory adequately.

True Intelligence. Perkins (1995) proposed a theory of what he refers to as *true intelligence*, which he believes synthesizes classic views as well as new ones. According to Perkins, there are three basic aspects to intelligence: neural, experiential, and reflective. Neural intelligence concerns what Perkins believes to be the fact that some people's neurological systems function better than do the neurological systems of others, running faster and with more precision. He mentions "more finely tuned voltages" and "more exquisitely adapted chemical catalysts" as well as a "better pattern of connectivity in the labyrinth of neurons" (Perkins, 1995, p. 97), although it is not entirely clear what any of these phrases means. Perkins believes this aspect of intelligence to be largely genetically determined and unlearnable. This kind of intelligence seems to be somewhat similar to Cattell's (1971) idea of fluid intelligence. The experiential aspect of intelligence is what has been learned from experience. It is the extent and organization of the knowledge base, and thus is similar to Cattell's notion of crystallized intelligence. The reflective aspect of intelligence refers to the role of strategies in memory and problem solving and appears to be similar to the construct of metacognition or cognitive monitoring (Brown & DeLoache, 1978; Flavell, 1981). There have been no published empirical tests of the theory of true intelligence, so it is difficult to evaluate the theory at this time. Like Gardner's (1983) theory, Perkins's theory is based on literature review, and as noted earlier, such literature reviews often tend to be selective and then interpreted in a way to maximize the theory's fit to the available data.

The Bioecological Model of Intelligence. Ceci (1996) proposed a bioecological model of intelligence, according to which multiple cognitive potentials, context, and knowledge all are essential bases of individual differences in performance. Each of the multiple cognitive potentials enables relationships to be discovered, thoughts to be monitored, and knowledge to be acquired within a given domain. Although these potentials are biologically based, their development is closely linked to environmental context, and hence it is difficult if not impossible cleanly to separate biological from environmental contributions to intelligence. Moreover, abilities may express themselves differently in different contexts. For example, children given essentially the same task in the context of a video game and in the context of a laboratory cognitive task performed much better when the task was presented in the context of the video game.

The bioecological model appears in many ways to be more a framework than a theory. At some level, the theory must be right. Certainly, both biological and ecological factors contribute to the development and manifestation of intelligence. Perhaps what the theory needs most at this time are specific and clearly falsifiable predictions that would set it apart from other theories.

Emotional Intelligence. Emotional intelligence is the ability to perceive accurately, appraise, and express emotion; the ability to access or generate feelings when they facilitate thought; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth (Mayer, Salovey & Caruso, 2000; Mayer, Salovey, Caruso, & Cherkasskiy, 2011). The concept was introduced by Salovey and Mayer (Mayer & Salovey, 1993; Salovey & Mayer, 1990) and popularized and expanded by Goleman (1995).

There is some evidence—though still tentative—for the existence of emotional intelligence. For example, Mayer and Gehr (1996) found that emotional perception of characters in a variety of situations correlated with SAT scores, with empathy, and with emotional openness. Full convergent discriminant validation of the construct, however, appears to be needed. The results to date are mixed, with some studies supportive (Mayer et al., 2000) and others not (Davies, Stankov, & Roberts, 1998).

There are some questions that no existing theories of intelligence answer. Consider a few of these.

CONCLUSIONS

The study of intelligence has come far in the century since Spearman (1904) published his seminal paper on general intelligence. Although there is no consensus as to what intelligence is or how to measure it, there are many viable alternatives. More research needs to distinguish among these alternatives rather than simply adducing evidence for any one of the alternatives. Among the psychometric theories, Carroll's (1993) has achieved fairly widespread acclaim, perhaps because it is based on a meta-analysis of so much empirical work. Because of its complexity, however, it is likely to have less influence on measurement than simpler theories, such as the theory of fluid and crystallized abilities (Cattell, 1971; Horn, 1994). History suggests that very complicated theories (e.g., Guilford, 1967, 1982; Guilford & Hoepfner, 1971; Guttman, 1954) tend not to have a long shelf life. In Guilford's case, however, it is more a compliment to than a criticism of his theory, because the demise of Guilford's theory is related to its falsifiability (Horn & Knapp, 1973), a property that not all modern theories have shown themselves to possess.

Challenges to Traditional Theories and Beliefs About Intelligence

Within recent years, several challenges from unexpected quarters have been proposed to theories and conceptions of intelligence. Two such challenges are the Flynn effect and dynamic testing.

The Flynn Effect

An empirical phenomenon challenges many theories of intelligence that view intelligence as some kind of fixed, largely genetically based trait. We know that the environment has powerful effects on cognitive abilities. Perhaps the simplest and most potent demonstration of this effect is what is called the *Flynn effect* (Flynn, 1984, 1987, 1994, 1998, 2011). The basic phenomenon is that IQ has increased over successive generations around the world through most of the century—at least since 1930. The effect must be environmental because a successive stream of genetic mutations obviously could not have taken hold and exerted such an effect over such a short period of time. The effect is powerful—about 15 points of IQ per generation for tests of fluid intelligence. And it occurs all over the world. The effect has been greater for tests of fluid intelligence than for tests of crystallized intelligence. The difference, if linearly extrapolated (a hazardous procedure, obviously), would suggest that a person who in 1892 fell at the 90th percentile on the Raven Progressive Matrices Test, a test of fluid intelligence, would, in 1992, score at the 5th percentile.

There have been many potential explanations of the Flynn effect, and in 1996 Ulric Neisser organized a conference at Emory University to try to explain the effect (Neisser, 1998). Some of the possible explanations include increased schooling, greater educational attainment of parents, better nutrition, and less childhood disease. A particularly interesting explanation is that of more and better parental attention to children (see Bronfenbrenner & Ceci, 1994). Whatever the answer, the Flynn effect suggests that we need to think carefully about the view that IQ is fixed. It probably is not fixed within individuals (Campbell & Ramey, 1994; Ramey, 1994), and it is certainly not fixed across generations.

Dynamic Assessment

In dynamic assessment, individuals learn at the time of test. If they answer an item correctly, they are given guided feedback to help them solve the item, either until they get it correct or until the examiner has run out of clues to give them.

The notion of dynamic testing appears to have originated with Vygotsky (1934/1962, 1978) and was developed independently by Feuerstein, Rand, Haywood, Hoffman, and Jensen (1985). Dynamic assessment is generally based on the notion that cognitive abilities are modifiable and that there is some zone of proximal development (Vygotsky, 1978), which represents the difference between actually developed ability and latent capacity. Dynamic assessments attempt to measure this zone of proximal development, or an analogue to it.

Dynamic assessment is cause for both celebration and caution (Grigorenko & Sternberg, 1998). On the one hand, it represents a break from conventional psychometric notions of a more or less fixed level of intelligence. On the other hand, it is more a promissory note than a realized success. The Feuerstein test, the Learning Potential Assessment Device (Feuerstein et al., 1985), is of clinical use but is not psychometrically normed or validated. There is only one formally normed test available in the United States (Swanson, 1995). This test yields scores for working memory before and at various points during and after training, as well as scores for amount of improvement with intervention, number of hints that have been given, and a subjective evaluation by the examiner of the examinee's use of strategies. Other tests are perhaps on the horizon (Guthke & Stein, 1996), but their potential for standardization and validity, too, remains to be shown.

Intelligence as Typical Performance

Traditionally, intelligence has been thought of as something to be conceptualized and measured in terms of maximum performance. The tests of intelligence have been maximum-performance tests, requiring examinees to work as hard as they can to maximize their scores. Ackerman (1994; Ackerman & Heggestad, 1997; Goff & Ackerman, 1992) has recently argued that typical-performance tests—which, like personality tests, do not require extensive intellectual effort—ought to supplement maximal-performance ones. On such tests individuals might be asked to what extent statements like "I prefer my life to be filled with puzzles I must solve" or "I enjoy work that requires conscientious, exacting skills" match their attitudes. A factor analysis of such tests yielded five factors: intellectual engagement, openness, conscientiousness, directed activity, and science-technology interest.

Ackerman's data suggest a weak relationship between his measures of typical performance and more conventional measures of maximum performance. What is needed most at this time are incremental validity studies that show that this theory provides significant incremental validity with respect to real-world task performance over the validity provided by available measures of intelligence. Because our intelligence so often is used in typical performance settings (Sternberg et al., 1981), future theorists will need to cope with the challenge of typical performance, following Ackerman's lead.

REFERENCES

Ackerman, P. (1994). Intelligence, attention, and learning: Maximal and typical performance. In D. K. Detterman (Ed.), *Current topics in human intelligence: Theories of intelligence* (Vol. 4, pp. 1–27). Norwood, NJ: Ablex.

Ackerman, P. L., & Heggestad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin, 121*, 219–245.

Azuma, H., & Kashiwagi, K. (1987). Descriptions for an intelligent person: A Japanese study. *Japanese Psychological Research, 29*, 17–26.

Barnett, S. M., Rindermann, H., Williams, W. M., & Ceci, S. J. (2011). Society and intelligence: The relevance of IQ for societal outcomes. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 666–682). New York, NY: Cambridge University Press.

Barrett, G. V., & Depinet, R. L. (1991). A reconsideration of testing for competence rather than for intelligence. *American Psychologist, 46*, 1012–1024.

Binet, A., & Simon, T. (1916). *The development of intelligence in children.* Baltimore, MD: Williams & Wilkins. (Originally published 1905)

Boring, E. G. (1923, June 6). Intelligence as the tests test it. *New Republic*, 35–37.

Bouchard, T. J. Jr. (1997). IQ similarity in twins reared apart: Findings and responses to critics. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Intelligence, heredity, and environment* (pp. 126–160). New York, NY: Cambridge University Press.

Bouchard, T. J. Jr., Lykken, D. T., McGue, M., Segal, N. L., & Tellegen, A. (1990). Sources of human psychological differences: The Minnesota study of twins reared apart. *Science, 250*, 223–228.

Brand, C. (1996). *The* g *factor: General intelligence and its implications.* Chichester, UK: Wiley.

Bronfenbrenner, U., & Ceci, S. J. (1994). Nature-nurture reconceptualized in developmental perspective: A bioecological model. *Psychological Review, 101*, 568–586.

Brown, A. L., & DeLoache, J. S. (1978). Skills, plans, and self-regulation. In R. Siegler (Ed.), *Children's thinking: What develops?* Hillsdale, NJ: Erlbaum.

Burt, C. (1949). Alternative methods of factor analysis and their relations to Pearson's method of "principal axis." *British Journal of Psychology, Statistical Section, 2*, 98–121.

Callahan, C. M., Tomlinson, C. A., & Plucker, J. (1997). *Project START using a multiple intelligences model in identifying and promoting talent in high-risk students* (Research Monograph 95136). Storrs: University of Connecticut, National Research Center on the Gifted and Talented.

Campbell, F. A., & Ramey, C. T. (1994). Effects of early intervention on intellectual and academic achievement: A follow-up study of children from low-income families. *Child Development, 65*, 684–698.

Carraher, T. N., Carraher, D., & Schliemann, A. D. (1985). Mathematics in the streets and in schools. *British Journal of Developmental Psychology, 3*, 21–29.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York, NY: Cambridge University Press.

Cattell, R. B. (1971). *Abilities: Their structure, growth and action.* Boston, MA: Houghton Mifflin.

Cattell, R. B., & Cattell, A. K. (1963). *Test of* g: *Culture fair, scale 3.* Champaign, IL: Institute for Personality and Ability Testing.

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology, 27*, 703–722.

Ceci, S. J. (1996). *On intelligence . . . More or less*. Cambridge, MA: Harvard University Press.

Ceci, S. J., & Liker, J. (1986). Academic and nonacademic intelligence: An experimental separation. In R. J. Sternberg & R. K. Wagner (Eds.), *Practical intelligence: Nature and origins of competence in the everyday world* (pp. 119–142). New York, NY: Cambridge University Press.

Ceci, S. J., & Roazzi, A. (1994). The effects of context on cognition: Postcards from Brazil. In R. J. Sternberg & R. K. Wagner (Eds.), *Mind in context: Interactionist perspectives on human intelligence* (pp. 74–101). New York, NY: Cambridge University Press.

Ceci, S. J., & Williams, W. M. (1997). Schooling, intelligence, and income. *American Psychologist, 52* (10), 1051–1058.

Chen, M. J. (1994). Chinese and Australian concepts of intelligence. *Psychology and Developing Societies, 6*, 101–117.

Chen, M. J., Braithwaite, V., & Huang, J. T. (1982). Attributes of intelligent behaviour: Perceived relevance and difficulty by Australian and Chinese students. *Journal of Cross-Cultural Psychology, 13*, 139–156.

Chen, M. J., & Chen, H. C. (1988). Concepts of intelligence: A comparison of Chinese graduates from Chinese and English schools in Hong Kong. *International Journal of Psychology, 223*, 471–487.

Connolly, H., & Bruner, J. (1974). Competence: Its nature and nurture. In K. Connolly & J. Bruner (Eds.), *The growth of competence.* New York, NY: Academic Press.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11*, 671–684.

Cronbach, L. J. (1957). The two disciplines of scientific psychology. *American Psychologist, 12*, 671–684.

Daniel, M. H. (2000). Interpretation of intelligence test scores. In R. J. Sternberg (Ed.), *Handbook of intelligence.* New York, NY: Cambridge University Press.

Das, J. P. (1994). Eastern views of intelligence. In R. J. Sternberg (Ed.), *Encyclopedia of human intelligence* (Vol. 1, p. 391). New York, NY: Macmillan.

Das, J. P., Kirby, J. R., & Jarman, R. F. (1979). *Simultaneous and successive cognitive processes.* New York, NY: Academic Press.

Dasen, P. (1984). The cross-cultural study of intelligence: Piaget and the Baoule. *International Journal of Psychology, 19*, 407–434.

Davies, M., Stankov, L., & Roberts, R. D. (1998). Emotional intelligence: In search of an elusive construct. *Journal of Personality & Social Psychology, 75*, 989–1015.

Davis, K., Christodoulou, J., Seider, S., & Gardner, H. (2011). The theory of multiple intelligences. In R. J. Sternberg & S. B. Kaufman

(Eds.), *Cambridge handbook of intelligence* (pp. 485–503). New York, NY: Cambridge University Press.

Deary, I. J. (2000). Simple information processing. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 267–284). New York, NY: Cambridge University Press.

Deary, I. J., & Stough, C. (1996). Intelligence and inspection time: Achievements, prospects, and problems. *American Psychologist, 51*, 599–608.

Dörner, D., & Kreuzig, H. (1983). Problemlosefahigkeit und intelligenz [Problem-solving ability and intelligence]. *Psychologische Rundschaus, 34*, 185–192.

Dörner, D., Kreuzig, H., Reither, F., & Staudel, T. (1983). *Lohhausen: Vom Umgang mit Unbestimmtheir und Komplexitat* [Lonhauser: On handling uncertainty and complexity]. Bern, Switzerland: Huber.

Durojaiye, M. O. A. (1993). Indigenous psychology in Africa. In U. Kim & J. W. Berry (Eds.), *Indigenous psychologies: Research and experience in cultural context.* Newbury Park, CA: Sage.

Feuerstein, R., Rand, Y., Haywood, H. C., Hoffman, M., & Jensen, M. (1985). *The learning potential assessment device (LPAD): Examiners' Manual.* Jerusalem: Hadassah-Wizo-Canada Research Institute.

Flavell, J. H. (1981). Cognitive monitoring. In W. P. Dickson (Ed.), *Children's oral communication skills* (pp. 35–60). New York, NY: Academic Press.

Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 95*, 29–51.

Flynn, J. R. (1987). Massive IQ gains in 14 nations. *Psychological Bulletin, 101*, 171–191.

Flynn, J. R. (1994). Giving *g* a fair chance: How to define intelligence, survive falsification, and resist behaviorism. *Psychological Inquiry, 5*, 204–208.

Flynn, J. R. (1998). WAIS-III and WISC-III gains in the United States from 1972 to 1995: How to compensate for obsolete norms. *Perceptual & Motor Skills, 86*, 1231–1239.

Flynn, J. R. (2011). Secular changes in intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 647–655). New York, NY: Cambridge University Press.

Fraser, S. (Ed.). (1995). *The bell curve wars: Race, intelligence and the future of America.* New York, NY: Basic Books.

Galton, F. (1883). *Inquiry into human faculty and its development.* London, UK: Macmillan.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences.* New York, NY: Basic Books.

Gardner, H. (1993). *Multiple intelligences: The theory in practice.* New York, NY: Basic Books.

Gardner, H. (1995). *Leading minds.* New York, NY: Basic Books.

Gardner, H. (1997). *Extraordinary minds: Portraits of exceptional individuals and an examination of our extraordinariness.* New York, NY: Basic Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century.* New York, NY: Basic Books.

Gardner, H. (2006). *Multiple intelligences: New horizons in theory and practice.* New York, NY: Basic Books.

Gardner, H., Feldman, D., & Krechevsky, M. (Eds.). (1998). *Project zero frameworks for early childhood education* (3 vols.). New York, NY: Teachers College Press.

Gardner, H., Krechevsky, M., Sternberg, R. J., & Okagaki, L. (1994). Intelligence in context: Enhancing students' practical intelligence for school. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 105–127). Cambridge, MA: MIT Press.

Gill, R., & Keats, D. M. (1980). Elements of intellectual competence: Judgments by Australian and Malay university students. *Journal of Cross-Cultural Psychology, 11*, 233–243.

Goff, M., & Ackerman, P. L. (1992). Personality-intelligence relations: Assessment of typical intellectual engagement. *Journal of Educational Psychology, 84*, 537–552.

Goleman, D. (1995). *Emotional intelligence.* New York, NY: Bantam Books.

Goodnow, J. J. (1976). The nature of intelligent behavior: Questions raised by cross-cultural studies. In L. Resnick (Ed.), *The nature of intelligence* (pp. 169–188). Hillsdale, NJ: Erlbaum.

Gottfredson, L. S. (Ed.). (1986). The *g* factor in employment [Special issue]. *Journal of Vocational Behavior, 29*, 293–450.

Gottfredson, L. S. (1997). Why *g* matters: The complexity of everyday life. *Intelligence, 24*, 79–132.

Gottfredson, L. S., & Deary, I. (2004). Intelligence predicts health and longevity, but why? *Current Directions in Psychological Science, 13*, 1–4.

Gould, S. J. (1981). *The mismeasure of man.* New York, NY: Norton.

Gould, S. J. (1995). Curveball. In S. Fraser (Ed.), *The bell curve wars* (pp. 11–22). New York, NY: Basic Books.

Grigorenko, E. L., Geissler, P. W., Prince, R., Okatcha, F., Nokes, C., Kenny, D. A., . . . Sternberg, R. J. (2001). The organization of Luo conceptions of intelligence: A study of implicit theories in a Kenyan village. *International Journal of Behavioral Development, 25*(4), 367–378.

Grigorenko, E. L., Jarvin, L., & Sternberg, R. J. (2002). School-based tests of the triarchic theory of intelligence: Three settings, three samples, three syllabi. *Contemporary Educational Psychology, 27*, 167–208.

Grigorenko, E. L., & Sternberg, R. J. (1998). Dynamic testing. *Psychological Bulletin, 124*, 75–111.

Guilford, J. P. (1967). *The nature of human intelligence.* New York, NY: McGraw-Hill.

Guilford, J. P. (1982). Is some creative thinking irrational? *Journal of Creative Behavior, 16*, 151–154.

Guilford, J. P., & Hoepfner, R. (1971). *The analysis of intelligence.* New York, NY: McGraw-Hill.

Gustafsson, J. E. (1984). A unifying model for the structure of intellectual abilities. *Intelligence, 8*, 179–203.

Gustafsson, J. E. (1988). Hierarchical models of the structure of cognitive abilities. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence* (Vol. 4, pp. 35–71). Hillsdale, NJ: Erlbaum.

Guthke, J., & Stein, H. (1996). Are learning tests the better version of intelligence tests? *European Journal of Psychological Assessment, 12*, 1–13.

Guttman, L. (1954). A new approach to factor analysis: The radex. In P. F. Lazarsfeld (Ed.), *Matermatical thinking in the social sciences* (pp. 258–348). New York, NY: Free Press.

Halstead, W. C. (1951). Biological intelligence. *Journal of Personality, 20*, 118–130.

Hebb, D. O. (1949). *The organization of behavior: A neuropsychological theory.* New York, NY: Wiley.

Herrnstein, R. & Murray, C. (1994). *The bell curve.* New York, NY: Free Press.

Horn, J. L. (1994). Theory of fluid and crystallized intelligence. In R. J. Sternberg (Ed.), *The encyclopedia of human intelligence* (Vol. 1, pp. 443–451). New York, NY: Macmillan.

Horn, J. L., & Knapp, J. R. (1973). On the subjective character of the empirical base of Guilford's structure-of-intellect model. *Psychological Bulletin, 80*, 33–43.

Hunt, E. (1995). *Will we be smart enough? A cognitive analysis of the coming workforce.* New York, NY: Sage.

Hunt, E. (2011a). *Human intelligence.* New York, NY: Cambridge University Press.

Hunt, E. (2011b). Where are we? Where are we going? Reflections on the current and future states of research on intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 863–885). New York, NY: Cambridge University Press.

Hunt, E., Frost, N., & Lunneborg, C. (1973). Individual differences in cognition: A new approach to intelligence. In G. Bower (Ed.), *The* *psychology of learning and motivation* (Vol. 7, pp. 87–122). New York, NY: Academic Press.

Hunt, E. B., Lunneborg, C., & Lewis, J. (1975). What does it mean to be high verbal? *Cognitive Psychology, 7*, 194–227.

Hunter, J. E., & Hunter, R. F. (1984). Validity and utility of alternative predictors of job performance. *Psychological Bulletin, 96*, 72–98.

"Intelligence and its measurement": A symposium. (1921). *Journal of Educational Psychology, 12*, 123–147, 195–216, 271–275.

Irvine, J. T. (1978). "Wolof magical thinking": Culture and conservation revisited. *Journal of Cross-Cultural Psychology, 9*, 300–310.

Jacoby, R., & Glauberman, N. (Eds.). (1995). *The bell curve debate.* New York, NY: Times Books.

Jensen, A. R. (1969). How much can we boost IQ and scholastic achievement? *Harvard Educational Review, 39*, 1–123.

Jensen, A. R. (1970). Hierarchical theories of mental ability. In W. B. Dockrell (Ed.), *On intelligence* (pp. 119–190). Toronto, Canada: Ontario Institute for Studies in Education.

Jensen, A. R. (1997). The puzzle of nongenetic variance. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Intelligence, heredity, and environment* (pp. 42–88). New York, NY: Cambridge University Press.

Jensen, A. R. (1998). *The* g *factor: The science of mental ability.* Westport, CT: Praeger/Greenwoood.

Jensen, A. R. (2002). Psychometric *g*: Definition and substantiation. In R. J. Sternberg & E. L. Grigorenko (Eds.), *General factor of intelligence: Fact or fiction.* Mahwah, NJ: Erlbaum.

Jensen, A. R. (2008). *Intelligence, race, and genetics: Conversations with Arthur R. Jensen.* Boulder, CO: Westview.

Johnson, R. Jr. (1986). A triarchic model of P300 amplitude. *Psychophysiology, 23*, 367–384.

Johnson, R. Jr. (1988). The amplitude of the P300 component of the vent-related potential: Review and synthesis. In P. K. Ackles, J. R. Jennings, & M. G. H. Coles (Eds.), *Advances in psychophysiology: A research manual* (Vol. 3, pp. 69–138). Greenwich, CT: CAI Press.

Kaufman, A. S., & Kaufman, N. L. (1983). *Kaufman assessment battery for children: Interpretive manual.* Circle Pines, MN: American Guidance Service.

Kaufman, A. S., & Kaufman, N. L. (1993). *Kaufman adolescent and adult intelligence test.* Circle Pines, MN: American Guidance Service.

Lave, J., Murtaugh, M., & de la Roche, O. (1984). The dialectic of arithmetic in grocery shopping. In B. Rogoff & J. Lace (Eds.), *Everyday cognition: Its development in social context* (pp. 67–94). Cambridge, MA: Harvard University Press.

Lemann, N. (1999). *The big test: The secret history of the American meritocracy.* New York, NY: Farrar, Straus, & Giroux.

Loehlin, J. C. (1989). Partitioning environmental and genetic contributions to behavioral development. *American Psychologist, 44*, 1285–1292.

Loehlin, J. C., Horn, J. M., & Willerman, L. (1997). Heredity, environment, and IQ in the Texas adoption project. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Intelligence, heredity, and environment* (pp. 105–125). New York, NY: Cambridge University Press.

Lohman, D. F. (2000). Complex information processing and intelligence. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 285–340). New York, NY: Cambridge University Press.

Lohman, D. F., & Lakin, J. M. (2011). Intelligence and reasoning. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 419–441). New York, NY: Cambridge University Press.

Luria, A. R. (1973). *The working brain.* New York, NY: Basic Books.

Luria, A. R. (1980). *Higher cortical functions in man* (2nd ed., rev. & expanded). New York, NY: Basic Books.

Lutz, C. (1985). Ethnopsychology compared to what? Explaining behaviour and consciousness among the Ifaluk. In G. M. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 35–79). Berkeley: University of California Press.

Mackintosh, N. J. (2011a). History of theory and measurement of intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 3–19). New York, NY: Cambridge University Press.

Mackintosh, N. J. (2011b). *IQ and human intelligence.* New York, NY: Oxford University Press.

Mandelman, S. D., & Grigorenko, E. L. (2011). Intelligence: Genes, environments, and everything in between. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 85–106). New York, NY: Cambridge University Press.

Mayer, J. D., & Gehr, G. (1996). Emotional intelligence and the identification of emotion. *Intelligence, 22*, 89–114.

Mayer, J. D., & Salovey, P. (1993). The intelligence of emotional intelligence. *Intelligence, 17*, 433–442.

Mayer, J. D., Salovey, P., & Caruso, D. (2000). Emotional intelligence. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 396–421). New York, NY: Cambridge University Press.

Mayer, J. D., Salovey, P., Caruso, D., & Cherkasskiy, L. (2011). Emotional intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 528–549). New York, NY: Cambridge University Press.

McClelland, D. C. (1973). Testing for competence rather than for "intelligence." *American Psychologist, 28*, 1–14.

Mundy-Castle, A. C. (1974). Social and technological intelligence in Western or Nonwestern cultures. *Universitas, 4*, 46–52.

Murtaugh, M. (1985). The practice of arithmetic by American grocery shoppers. *Anthropology and Education Quarterly, 16*, 186–192.

Naglieri, J. A., & Das, J. P. (1990). Planning, attention, simultaneous, and successive cognitive processes as a model for intelligence. *Journal of Psychoeducational Assessment, 8*, 303–337.

Naglieri, J. A., & Das, J. P. (1997). *Cognitive Assessment System.* Itasca, IL: Riverside Publishing.

Naglieri, J. A., & Das, J. P. (2002). Practical implications of general intelligence and PASS cognitive processes. In R. J. Sternberg & E. L. Grigorenko (Eds.), *The general factor of intelligence: Fact or fiction.* Mahwah, NJ: Erlbaum.

Neisser, U. (Ed.). (1998). *The rising curve.* Washington, DC: American Psychological Association.

Nettlebeck, T. (1982). Inspection time: An index for intelligence. *Quarterly Journal of Experimental Psychology, 34*, 299–312.

Nettlebeck, T. (2011). Basic processes of intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 371–393). New York, NY: Cambridge University Press.

Newell, A., & Simon, H. A. (1972). *Human problem solving.* Englewood Cliffs, NJ: Prentice-Hall.

Nuñes, T. (1994). Street intelligence. In R. J. Sternberg (Ed.), *Encyclopedia of human intelligence* (Vol. 2, pp. 1045–1049). New York, NY: Macmillan.

Ogbu, J. U. (1978). *Minority education and caste: The American system in cross-cultural perspective.* New York, NY: Academic Press.

Ogbu, J. U. (1991). Low school performance as an adaptation: The case of blacks in Stockton, CA. In M. A. Gibson & J. U. Ogbu (Eds.), *Minority status and schooling: A comparative study of immigrant and involuntary minorities* (pp. 249–286). New York, NY: Garland.

Ogbu, J. U. (1994). From cultural differences to differences in cultural frame of reference. In P. M. Greenfield & R. R. Cocking (Ed.), *Cross-cultural roots of minority child development* (pp. 365–391). Hillsdale, NJ: Erlbaum.

Ogbu, J. U., & Stern, P. (2001). Caste status and intellectual development. In R. S. Sternberg & E. L. Grigorenko (Eds.), *Environmental effects on intellectual functioning* (pp. 3–37). Hillsdale, NJ: Erlbaum.

Okagaki, L., & Sternberg, R. J. (1993). Parental beliefs and children's school performance. *Child Development, 64*, 36–56.

Pedersen, N. L., Plomin, R., Nesselroade, J. R., & McClearn, G. E. (1992). A quantitative genetic analysis of cognitive abilities during the second half of the life span. *Psychological Science, 3*, 346–353.

Perkins, D. N. (1995). *Outsmarting IQ: The emerging science of learnable intelligence.* New York, NY: Free Press.

Petrill, S. A. (2002). The case for general intelligence: A behavioral genetic perspective. In R. J. Sternberg & E. L. Grigorenko (Eds.), *The general factor of intelligence: How general is it?* (pp. 281–298). Mahwah, NJ: Erlbaum.

Plomin, R. (1997). Identifying genes for cognitive abilities and disabilities. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Intelligence, heredity, and environment* (pp. 89–104). New York, NY: Cambridge University Press.

Plomin, R., DeFries, J. C., McClearn, G. E., & McGuffin, P. (2008). *Behavioral genetics.* New York, NY: Worth.

Plomin, R., DeFries, J. C., McClearn, G. E., & Rutter, M. (1997). *Behavioral genetics* (3rd ed.). New York, NY: Freeman.

Plomin, R., McClearn, D. L., & Smith, D. L. (1994). DNA markers associated with high versus low IQ: The IQ QTL Project. *Behavior Genetics, 24*, 107–118.

Plomin, R., McClearn, D. L., & Smith, D. L. (1995). Allelic associations between 100 DNA markers and high versus low IQ. *Intelligence, 21*, 31–48.

Plomin, R., & Neiderhiser, J. M. (1992). Quantitative genetics, molecular genetics, and intelligence. *Intelligence, 15*, 369–387.

Plomin, R., & Petrill, S. A. (1997). Genetics and intelligence: What is new? *Intelligence, 24*, 53–78.

Poole, F. J. P. (1985). Coming into social being: Cultural images of infants in Bimin-Kuskusmin folk psychology. In G. M. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 183–244). Berkeley: University of California Press.

Posner, M. I., & Mitchell, R. F. (1967). Chronometric analysis of classification. *Psychological Review, 74*, 392–409.

Putnam, D. B., & Kilbride, P. L. (1980). *A relativistic understanding of social intelligence among the Songhay of Mali and Smaia of Kenya.* Paper presented at the meeting of the Society for Cross-Cultural Research, Philadelphia, PA.

Ramey, C. T. (1994). Abecedarian Project. In R. J. Sternberg (Ed.), *Encyclopedia of human intelligence* (Vol. 1, pp. 1–2). New York, NY: Macmillan.

Reed, T. E., & Jensen, A. R. (1992). Conduction velocity in a brain nerve pathway of normal adults correlates with intelligence level. *Intelligence, 16*, 259–272.

Roid, G. (2003). *Stanford-Binet intelligence scales* (5th ed.). Itasca, IL: Riverside.

Ruzgis, P. M., & Grigorenko, E. L. (1994). Cultural meaning systems, intelligence and personality. In R. J. Sternberg & P. Ruzgis (Eds.), *Personality and intelligence* (pp. 248–270). New York, NY: Cambridge University Press.

Sacks, P. (1999). *Standardized minds: The high price of America's testing culture and what we can do to change it.* Cambridge, MA: Perseus Books.

Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, cognition, and personality, 9*, 185–211.

Scarr, S. (1997). Behavior-genetic and socialization theories of intelligence: Truce and reconciliation. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Intelligence, heredity and environment* (pp. 3–41). New York, NY: Cambridge University Press.

Schmidt, F. L., & Hunter, J. E. (1981). Employment testing: Old theories and new research findings. *American Psychologist, 36*, 1128–1137.

Schmidt, F. L., & Hunter, J. E. (1993). Tacit knowledge, practical intelligence, general mental ability, and job knowledge. *Current Directions in Psychological Science, 1*, 8–9.

Schmidt, F., & Hunter, J. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin, 124*, 262–274.

Scribner, S. (1984). Studying working intelligence. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context* (pp. 9–40). Cambridge, MA: Harvard University Press.

Scribner, S. (1986). Thinking in action: Some characteristics of practical thought. In R. J. Sternberg & R. K. Wagner (Eds.), *Practical intelligence: Nature and origins of competence in the everyday world* (pp. 13–30). New York, NY: Cambridge University Press.

Serpell, R. (1974). Aspects of intelligence in a developing country. *African Social Research, 17*, 576–596.

Serpell, R. (1982). Measures of perception, skills, and intelligence. In W. W. Hartup (Ed.), *Review of child development research* (Vol. 6, pp. 392–440). Chicago, IL: University of Chicago Press.

Serpell, R. (1993). *The significance of schooling: Life journeys in an African society.* New York, NY: Cambridge University Press.

Spearman, C. (1904). "General intelligence," objectively determined and measured. *American Journal of Psychology, 15*(2), 201–293.

Spearman, C. (1923). *The nature of "intelligence" and the principles of cognition* (2nd ed.). London, UK: Macmillan.

Spearman, C. (1927). *The abilities of man.* London, UK: Macmillan.

Srivastava, A. K., & Misra, G. (1996). Changing perspectives on understanding intelligence: An appraisal. *Indian Psychological Abstracts and Review, 3*, 1–34.

Stenhouse, D. (1973). *The evolution of intelligence: A general theory and some of its implications.* New York, NY: Harper & Row.

Sternberg, R. J. (1977). *Intelligence, information processing, and analogical reasoning: The componential analysis of human abilities.* Hillsdale, NJ: Erlbaum.

Sternberg, R. J. (1980). Representation and process in linear syllogistic reasoning. *Journal of Experimental Psychology: General, 109*, 119–159.

Sternberg, R. J. (1983). Components of human intelligence. *Cognition, 15*, 1–48.

Sternberg, R. J. (1984). Toward a triarchic theory of human intelligence. *Behavioral and Brain Sciences, 7*, 269–287.

Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence.* New York, NY: Cambridge University Press.

Sternberg, R. J. (1990). *Metaphors of mind: Conceptions of the nature of intelligence.* New York, NY: Cambridge University Press.

Sternberg, R. J. (1995). For whom the bell curve tolls: A review of *The Bell Curve*. *Psychological Science, 6*, 257–261.

Sternberg, R. J. (1997). *Successful intelligence.* New York, NY: Plume.

Sternberg, R. J. (1999a). Human intelligence: A case study of how more and more research can lead us to know less and less about a psychological phenomenon, until finally we know much less than we did before we started doing research. In E. Tulving (Ed.), *Memory, consciousness, and the brain: The Tallinn Conference* (pp. 363–373). Philadelphia, PA: Psychology Press.

Sternberg, R. J. (1999b). A propulsion model of types of creative contributions. *Review of General Psychology*, *3*, 83–100.

Sternberg, R. J. (1999c). Successful intelligence: Finding a balance. *Trends in Cognitive Sciences, 3*, 436–442.

Sternberg, R. J. (1999d). The theory of successful intelligence. *Review of General Psychology, 3*, 292–316.

Sternberg, R. J. (2011). The theory of successful intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 504–527). New York, NY: Cambridge University Press.

Sternberg, R. J. (2003). *Wisdom, intelligence, and creativity, synthesized.* New York, NY: Cambridge University Press.

Sternberg, R. J., Conway, B. E., Ketron, J. L., & Bernstein, M. (1981). People's conceptions of intelligence. *Journal of Personality and Social Psychology, 41*, 37–55.

Sternberg, R. J., & Detterman, D. K. (1986). *What is intelligence?* Norwood, NJ: Ablex.

Sternberg, R. J., Ferrari, M., Clinkenbeard, P. R., & Grigorenko, E. L. (1996). Identification, instruction, and assessment of gifted children: A construct validation of a triarchic model. *Gifted Child Quarterly, 40*, 129–137.

Sternberg, R. J., Forsythe, G. B., Hedlund, J., Horvath, J., Snook, S., Williams, W. M., . . . Grigorenko, E. L. (2000). *Practical intelligence.* New York, NY: Cambridge University Press.

Sternberg, R. J., & Gardner, M. K. (1983). Unities in inductive reasoning. *Journal of Experimental Psychology: General, 112*, 80–116.

Sternberg, R. J., & Grigorenko, E. L. (Eds.). (1997). *Intelligence, heredity, and environment.* New York, NY: Cambridge University Press.

Sternberg, R. J., Grigorenko, E. L., Ferrari, M., & Clinkenbeard, P. (1999). A triarchic analysis of an aptitude-treatment interaction. *European Journal of Psychological Assessment, 15*, 1–11.

Sternberg, R. J., & Lubart, T. I. (1995). *Defying the crowd: Cultivating creativity in a culture of conformity.* New York, NY: Free Press.

Sternberg, R. J., & Lubart, T. I. (1996). Investing in creativity. *American Psychologist, 51*, 677–688.

Sternberg, R. J., Okagaki, L., & Jackson, A. (1990). Practical intelligence for success in school. *Educational Leadership, 48*, 35–39.

Sternberg, R. J., Torff, B., & Grigorenko, E. L. (1998). Teaching triarchically improves school achievement. *Journal of Educational Psychology, 90*, 1–11.

Sternberg, R. J., & Wagner, R. K. (1993). The *g*-ocentric view of intelligence and job performance is wrong. *Current Directions in Psychological Science, 2*, 1–4.

Sternberg, R. J., Wagner, R. K., Williams, W. M., & Horvath, J. A. (1995). Testing common sense. *American Psychologist, 50*, 912–927.

Sternberg, R. J., & Williams, W. M. (1997). Does the graduate record examination predict meaningful success in the graduate training of psychologists? A case study. *American Psychologist, 52*, 630–641.

Super, C. M. (1983). Cultural variation in the meaning and uses of children's intelligence. In J. B. Deregowski, S. Dziurawiec, & R. C. Annis (Eds.), *Expiscations in cross-cultural psychology* (pp. 199–212). Lisse, The Netherlands: Swets and Zeitlinger.

Super, C. M., & Harkness, S. (1982). The development of affect in infancy and early childhood. In D. Wagnet & H. Stevenson (Eds.), *Cultural perspectives on child development* (pp. 1–19). San Francisco, CA: Freeman.

Swanson, H. L. (1995). Effects of dynamic testing on the classification of learning disabilities: The predictive and discriminant validity of the Swanson cognitive processing test. *Journal of Psychoeducational Assessment, 1*, 204–229.

Thurstone, L. L. (1924). *The nature of intelligence.* New York, NY: Harcourt Brace.

Thurstone, L. L. (1938). *Primary mental abilities.* Chicago, IL: University of Chicago Press.

Urbina, S. (2011). Tests of intelligence: Their whys and wherefores. In R. J. Sternberg & S. B. Kaufman (Eds.), *Cambridge handbook of intelligence* (pp. 20–38). New York, NY: Cambridge University Press.

Vernon, P. A., & Mori, M. (1992). Intelligence, reaction times, and peripheral nerve conduction velocity. *Intelligence, 8*, 273–288.

Vernon, P. E. (1971). *The structure of human abilities.* London, UK: Methuen.

Vernon, P. A., Wickett, J. C., Bazana, P. G., & Stelmack, R. M. (2000). The neuropsychology and psycholophysiology of human intelligence. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 245–264). New York, NY: Cambridge University Press.

Vygotsky, L. S. (1962). *Thought and language.* Cambridge, MA: MIT Press. (Original work published 1934)

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wahlsten, D., & Gottlieb, G. (1997). The invalid separation of effects of nature and nurture: Lessons from animal experimentation. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Intelligence, heredity, and environment* (pp. 163–192). New York, NY: Cambridge University Press.

Wechsler, D. (2002). *Wechsler preschool and primary scale of intelligence III.* San Antonio, TX: Harcourt.

Wechsler, D. (2003). *Manual for the Wechsler intelligence scales for children* (4th ed.). San Antonio, TX: Harcourt.

White, G. M. (1985). Premises and purposes in a Solomon Islands ethnopsychology. In G. M. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 328–366). Berkeley: University of California Press.

Wickett, J. C., & Vernon, P. A. (1994). Peripheral nerve conduction velocity, reaction time, and intelligence: An attempt to replicate Vernon and Mori. *Intelligence, 18*, 127–132.

Wigdor, A. K., & Garner, W. R. (Eds.). (1982). *Ability testing: Uses, consequences, and controversies.* Washington, DC: National Academy Press.

Willerman, L., Schultz, R., Rutledge, J. N., & Bigler, E. D. (1991). In vivo brain size and intelligence. *Intelligence, 15*, 223- 228.

Willerman, L., Schultz, R., Rutledge, J. N., & Bigler, E. D. (1992). Hemisphere size asymmetry predicts relative verbal and nonverbal intelligence differently in the sexes: An MRI study of structure function relations. *Intelligence, 16*, 315–328.

Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson Tests of Cognitive Ability-Revised.* Itasca, IL: Riverside.

Yang, S., & Sternberg, R. J. (1997a). Conceptions of intelligence in ancient Chinese philosophy. *Journal of Theoretical and Philosophical Psychology, 17*(2), 101–119.

Yang, S., & Sternberg, R. J. (1997b). Taiwanese Chinese people's conceptions of intelligence. *Intelligence, 25*(1), 21–36.

Zenderland, L. (1998). *Measuring minds: Henry Goddard and the origins of American intelligence testing*. New York, NY: Cambridge University Press.

CHAPTER 3

Self-Regulation and Learning

DALE H. SCHUNK AND BARRY J. ZIMMERMAN

SELF-REGULATION AND LEARNING

Self-regulation (or *self-regulated learning*) refers to learning that results from students' self-generated thoughts and behaviors that are systematically oriented toward the attainment of their learning goals (Zimmerman, 2000). Self-regulated learning involves goal-directed activities that students instigate, modify, and sustain (Zimmerman, 2008); for example, attending to instruction, processing of information, rehearsing and relating new learning to prior knowledge, believing that one is capable of learning, and establishing productive social relationships and work environments (Zimmerman & Schunk, 2004). Self-regulated learning fits well with a central feature of cognitive theories of learning that students are active seekers and processors of information who contribute actively to their learning goals and exercise control over goal attainment. Self-regulation also is integral to the field of educational psychology, which addresses such topics as learning, achievement, and motivation in educational settings and provides theoretically and empirically based suggestions of ways to apply principles to improve teaching and learning. Research evidence supports the point that self-regulatory processes influence learners' achievement cognitions, behaviors, and emotions (Schunk & Zimmerman, 2008; Zimmerman & Schunk, 2011).

We initially discuss some assumptions of theories of self-regulation, after which we explain five theories of self-regulation: operant, information processing, developmental, social constructivist, and social cognitive. With this theoretical background in place, we discuss self-regulation research that identified self-regulatory processes and examined the operation of self-regulatory processes during learning. We also describe in detail two interventions designed to enhance students' self-regulation. The chapter concludes with suggestions for future research directions.

THEORIES OF SELF-REGULATION

Theories of self-regulation differ in many ways but they make some common assumptions about the nature of self-regulation. These are discussed next, after which the theories are described.

Assumptions

Theory and research on academic self-regulation was prompted by investigations into individuals' behavioral self-control in such areas as personal management and task completion (Karoly & Kanfer, 1982). Self-regulation researchers have explored whether the same self-regulatory processes improve academic learning, motivation, and achievement (Zimmerman, 2001).

Various theoretical accounts have been advanced for academic self-regulation. In this section we address five perspectives. We selected these because each has a solid theoretical and empirical base for self-regulation.

Regardless of perspective, they stress common features (Zimmerman, 2001). One is that individuals are self-regulated to the extent that they are behaviorally, metacognitively, and motivationally active in their own learning and performance. Learner activity lies at the core of cognitive theories of learning and motivation. A second feature is that self-regulation is a cyclical process comprising feedback loops (Lord, Diefendorff, Schmidt, & Hall, 2010). Persons set goals and monitor their progress toward them. They respond to this self-monitoring, as well as to external feedback, in various ways to attain their goals, such as by working harder or changing their strategy. A third common feature is an emphasis on why persons choose to self-regulate. Effective self-regulation requires not only knowing what to do and how to do it but also regulating one's motivation and emotional involvement (Pintrich, 2000; Schunk & Zimmerman, 2008).

Table 3.1 summarizes the key features of the theories discussed in this section. Operant theory is discussed first, because many of the earliest investigations of self-regulation were conducted by researchers in this tradition and because its principles help set the context for the development of the other four theories that stress cognitive features.

Operant Theory

The views of operant theorists about self-regulation derive primarily from the theory and research by Skinner (1953). Operant (voluntary) behavior is emitted in the presence of discriminative stimuli, or those to which people may respond. Whether behavior becomes more or less likely to occur in the future depends on its consequences. Behaviors that are reinforced (followed by positive consequences) are more likely to be repeated, whereas those punished (followed by negative consequences) are less apt to occur. Thus, assume that a teacher praises a student after the student gives a correct answer in class. The praise is a reinforcer if it encourages the student to continue volunteering answers. Conversely, if the teacher criticizes a student after the student gives an incorrect answer, the criticism is a form of punishment if it decreases the likelihood of the student volunteering answers.

TABLE 3.1 Key Features of Self-Regulation Theories

Theory	Key features
Operant	Behaviors (self-monitoring, self-instruction, self-reinforcement)
Information Processing	Cognitive processes (attention, coding, storage, retrieval, metacognition); learning strategies
Developmental	Improvements in cognitive processes with development; private speech
Social Constructivist	Construction of theories of self-identity, tasks, and strategies; cultural tools (languages, symbols); zone of proximal development
Social Cognitive	Reciprocal interactions among personal, behavioral, and social/environmental factors; cyclical process comprising forethought, performance control, and self-reflection

Operant theorists have studied how individuals establish discriminative stimuli and reinforcement contingencies (prescribed consequences for various behaviors; Brigham, 1982). Self-regulated behavior involves choosing among alternative courses of action (Mace, Belfiore, & Shea, 1989), typically by deferring an immediate reinforcer in favor of a different and usually greater future reinforcer. For example, assume that Brad spends insufficient time studying and is easily distracted. A key to producing more-effective studying is to establish discriminative stimuli (cues) for studying. With the assistance of his school counselor, Brad establishes a definite time and place for studying (6 to 9 P.M. in his room with two 10-minute breaks). To eliminate distracting cues, Brad agrees not to use his cell phone or any electronic devices during this period. For reinforcement, Brad will award himself one point for each night he successfully accomplishes his routine. When he receives 10 points, he will earn a night off.

From the perspective of operant theory, one decides which behaviors to regulate, establishes discriminative stimuli for their occurrence, evaluates performance in terms of whether it matches the standard, and administers reinforcement (Mace, Belfiore, & Hutchinson, 2001). Three key processes are self-monitoring, self-instruction, and self-reinforcement.

Self-Monitoring

Self-monitoring refers to deliberate attention to some aspect of one's behavior, and often is accompanied by recording its frequency or intensity (Mace et al., 2001). People cannot regulate their actions if they are not aware of what they do. Behaviors can be assessed on such dimensions as quality, rate, quantity, and originality. While writing a term paper, students may periodically assess their work to determine whether it states important ideas, is long enough, and integrates ideas in a coherent fashion. One can engage in self-monitoring in such diverse areas as motor skills (e.g., how fast one runs the 100-meter dash), art (e.g., how original one's pen-and-ink drawings are), and social behavior (e.g., how much one interacts at social functions).

Often students must be taught self-monitoring methods (Belfiore & Hornyak, 1998; Lan, 1998). Methods include narrations, frequency counts, duration measures, time-sampling measures, behavior ratings, and behavioral traces and archival records (Mace et al., 1989). *Narrations* are written accounts of behavior and the context in which it occurs. Narrations can range from detailed to open-ended. *Frequency counts* are used to record instances of specific behaviors during a given period (e.g., number of times a student turns around in his or her seat during a 30-minute seatwork exercise). *Duration measures* record the amount of time a behavior occurs during a given period (e.g., number of minutes a student studies during 30 minutes). *Time-sampling measures* divide a period into shorter intervals and record how often a behavior occurs during each interval. A 30-minute study period might be divided into six 5-minute periods; for each 5-minute period, students record whether they studied the entire time. *Behavior ratings* require estimates of how often a behavior occurs during a given time (e.g., always, sometimes, never). *Behavioral traces and archival records* are permanent records that exist independently of other assessments (e.g., number of worksheets completed, number of problems solved correctly).

In the absence of self-recording, people's memories of successes and failures become more selective and their beliefs about outcomes may not faithfully reflect actual outcomes. Self-recording often yields surprising results. Students having difficulties studying who keep a written record of their activities may learn they are wasting most of their study time on nonacademic tasks.

Two important self-monitoring criteria are regularity and proximity (Bandura, 1986). *Regularity* means observing behavior continually rather than intermittently, such as by keeping a daily record rather than recording behavior once a week. Nonregular observation requires accurate memory and often yields misleading results. *Proximity* means observing behavior close in time to its occurrence rather than long afterwards. It is better to write down what we do at the time it occurs rather than wait until the end of the day to reconstruct events.

In addition to self-monitoring overt behaviors, students also can be taught to self-monitor their attention (Harris, Graham, MacArthur, Reid, & Mason, 2011). For example, students can learn to self-assess and self-record whether they are attending to and working on the task. The self-monitoring of attention has been shown in research to improve students' attention and academic achievement (Harris et al.).

Self-monitoring places responsibility for assessment on the person doing the monitoring (Belfiore & Hornyak, 1998). Self-monitored responses are consequences of behaviors, and like other consequences affect future responding. Self-recordings are immediate responses that serve to bridge the relation between preceding behavior and longer-term consequences (Mace & West, 1986). Students who monitor their completion of assignments provide themselves with immediate reinforcers that link their prior work and distant consequences such as teacher praise and high grades (Harris, Graham, Mason & Friedlander, 2008; Mace et al., 2001).

Self-monitoring is a critical component of many theories of self-regulation and can, by itself, lead to behavioral improvements (Belfiore & Hornyak, 1998). Reid, Trout, and Schartz (2005) reviewed the research literature on self-regulation interventions among children with attention deficits and hyperactivity. Self-monitoring alone and in combination with self-reinforcement often was a component of effective interventions.

Self-Instruction

Self-instruction refers to discriminative stimuli that set the occasion for self-regulatory responses leading to reinforcement (Mace et al., 1989). One type of self-instruction involves arranging the environment to produce discriminative stimuli. Students who realize they need to review class notes the next day might write themselves a reminder before going to bed. The written reminder serves as a discriminative stimulus to review, which makes reinforcement (i.e., a good grade on a quiz) more likely.

Another type of self-instruction takes the form of statements that serve as discriminative stimuli to guide behavior. Self-instructional statements have been used to teach a variety of academic, social, and motor skills. Strategy instruction is an effective means of enhancing comprehension and achievement beliefs among remedial readers. Schunk and Rice (1987) taught remedial readers the following strategy, and they verbalized the individual six steps prior to applying them to reading comprehension passages:

1. What do I have to do?
2. Read the questions.
3. Read the passage to find out what it is mostly about.
4. Think about what the details have in common.
5. Think about what would make a good title.
6. Reread the story if I don't know the answer to a question.

Verbalizing statements keeps students focused on a task, which may be especially beneficial for learners with attention deficits. Kosiewicz, Hallahan, Lloyd, and Graves

(1982) used the following self-instruction procedure to improve the handwriting of a student with learning disabilities:

- Say aloud the word to be written.
- Say the first syllable.
- Name each of the letters in that syllable three times.
- Repeat each letter as it is written down.
- Repeat steps 2 through 4 for each succeeding syllable.

Other researchers also have found statement verbalization to assist students to learn and apply a strategy to improve their performances. Using the Self-Regulated Strategy Development program (discussed later in this chapter), Reid and Lienemann (2006) had teachers explain and demonstrate use of a writing strategy by verbalizing and applying statements such as, “What is my goal?” and “What is my next step?”

Self-Reinforcement

Self-reinforcement is the process whereby people provide themselves with reinforcement contingent on performing a response and the reinforcement increases the likelihood of future responding (Mace et al., 1989). Although research shows that reinforcement contingencies improve academic performance (Bandura, 1986), it is unclear whether self-reinforcement is more effective than externally administered reinforcement (such as given by a teacher). Studies investigating self-reinforcement often contain problems that make it difficult to discern the isolated effects of this intervention (Brigham, 1982). In academic settings, the reinforcement contingency usually occurs in classrooms that include instruction and rules. Students typically do not work on materials when they choose but rather when told to do so by the teacher. Students may stay on task primarily because of the teacher’s classroom control rather than because of reinforcement.

Self-reinforcement is hypothesized to be an effective component of self-regulated behavior (O’Leary & Dubey, 1979), but the reinforcement may be more important than its agent (self or others). Although self-reinforcement may enhance behavioral maintenance over time, explicitly providing reinforcement may be more important while self-regulation skills are being learned. In the Reid and Lienemann (2006) project, students also verbalized self-reinforcing statements (e.g., “I like that part!”).

Critique

Although behavioral methods promote functional behaviors, the operant theory approach has some problems. By focusing only on behavior, operant theory ignores the cognitive and motivational aspects of self-regulation. Operant theory defines motivation in behavioral terms as the increased rate or duration of behavior, but this neglects the important cognitive and affective components of motivation such as beliefs and emotions. Behavioral methods are effective in the short term for increasing on-task behaviors, but self-regulation becomes more important over the longer term such as writing a dissertation or obtaining a college degree. A more-elaborate perspective on self-regulation is needed for goals and actions that extend beyond the immediate.

Information Processing Theory

Principles

Information processing theories view learning as the encoding of information in long-term memory. Learners activate relevant portions of long-term memory and relate new knowledge to existing information in working (short-term) memory, or the memory of immediate consciousness. Organized, meaningful information is easier to integrate with existing knowledge and more likely to be remembered (Matlin, 2009).

From an information processing perspective, self-regulation is roughly equivalent to *metacognitive awareness* or *metacognition* where individuals monitor, direct, and regulate actions toward goals (Gitomer & Glaser, 1987; S. Paris & Paris, 2001). This awareness includes knowledge of the task (what is to be learned, when and how it is to be learned), as well as self-knowledge of personal capabilities, interests, and attitudes. Self-regulated learning requires learners to have knowledge about task demands, personal qualities, and strategies for completing the task (Hadwin, Järvelä, & Miller, 2011; Winne, 2011).

Metacognitive awareness also includes procedural knowledge that regulates learning of the material by monitoring one’s level of learning, deciding when to take a different task approach, and assessing readiness for a test. Self-regulatory (metacognitive) activities are types of *control processes* under the learner’s direction. They facilitate processing and movement of information through the system.

The basic (superordinate) unit of self-regulation may be a problem-solving *production system*, where the problem is to reach the goal and the monitoring serves to ascertain whether the learner is making progress (Anderson, 1996, 2000). This system compares the present situation against a standard and attempts to reduce discrepancies.

An early formulation was Miller, Galanter, and Pribram’s (1960) *Test-Operate-Test-Exit (TOTE) model*. The initial test phase compares the present situation against a standard. If they are the same, no further action is required. If they do not match, control is switched to the operate function to change behavior to resolve the discrepancy. One perceives a new state of affairs that is compared with the standard during the second test phase. When these match, one exits the model. If they do not match, further behavioral changes and comparisons are necessary.

To illustrate, assume that Jenny is reading her history text and stops periodically to summarize what she has read. She recalls information from long-term memory pertaining to what she has read and compares the information to her internal standard of an adequate summary. This standard also may be a production characterized by rules (e.g., be accurate, include information on all topics covered) developed through experiences in summarizing. She continues reading if her summary matches her standard. If they do not match, she evaluates where the problem lies (in her understanding of the second paragraph) and performs a correction strategy (rereads the second paragraph).

Winne and Hadwin (1998, 2008; Winne, 2001, 2011) developed an information processing model of self-regulated learning that is highly relevant to education (Greene & Azevedo, 2007). This model comprises three necessary phases (definition of task, goals and plans, studying tactics) and one optional phase (adaptations).

In the first phase, learners process information about the conditions that characterize the task in order to clearly define it (Winne, 2001). There are two main sources of information. Task conditions include information about the task that learners interpret based on the external environment (e.g., teacher's directions for an assignment). Cognitive conditions are those that learners retrieve from long-term memory. These include information about how they did on prior work, as well as motivational variables (e.g., perceived competence, attributions). In the second phase, learners decide on a goal and a plan for attaining it. The plan will include relevant learning strategies. As they begin to apply these strategies they move into the third phase (studying tactics). In the fourth phase students make adaptations to their plans based on their evaluations of how successful they are. This phase is optional; it is not needed if the original plan is successful.

Within each phase, information processing occurs and constructs information products, or new information. Information processes work on existing information and are characterized by the acronym SMART: searching, monitoring, assembling, rehearsing, translating. Searching refers to scanning memory locations to retrieve information; monitoring involves comparing retrieved information with desired information to form new knowledge; assembling creates new links in memory between new and previously-stored information; rehearsing involves repeating new information or using strategies to prevent it from being lost; and translating is the process of creating a new representational format (e.g., words) from another (e.g., mental images; Winne, 2001).

Working on a task requires using a schema, or script, and each script has five possible slots to fill characterized by the acronym COPES: conditions, operations, products, evaluations, standards. Conditions are resources available to work on a task, such as beliefs, motivational processes, and prior knowledge. Operations are used to process information (e.g., methods, strategies). Products are new pieces of information created by using the SMART processes; for example, new goals and adapted strategies. Evaluations involve determining whether products meet standards or whether more work on products is needed. Standards refer to qualities that products should have (e.g., accuracy, comprehensiveness; Winne, 2001).

Figuratively speaking, these are the elements a student "copes with" to learn (Winne, 2001). Information processing outcomes are judged against standards and these evaluations (e.g., on target, too high) serve as the basis for bring new conditions to bear on the student's learning activities.

The importance of this model for education derives heavily from its development and use with learning content and on its inclusion of motivational variables. These motivational variables are combined with cognitive variables to determine the usefulness of a particular self-regulatory script. This model represents an advance over traditional and contemporary cognitive information processing models that emphasize cognitive components. Much research supports the idea that motivational variables are important during self-regulated learning (Schunk & Zimmerman, 2008).

There are other information processing models of self-regulation (e.g., Carver & Scheier, 1998), including those that focus on the role and development of self-regulation in technological environments (Azevedo, Johnson, Chauncey, & Graesser, 2011; Schraw, 2007), but they are in agreement in their emphasis on learning strategies. These are discussed next.

Learning Strategies

Learning strategies are cognitive plans oriented toward successful task performance (Pressley et al., 1990; Weinstein & Mayer, 1986). Strategies include such activities as selecting and organizing information, rehearsing material to be learned, relating new material to information in memory, and enhancing meaningfulness of material. Strategies also include techniques to create and maintain a positive emotional climate; for example, ways to overcome test anxiety, enhance self-efficacy, appreciate the value of learning, and develop positive attitudes (Weinstein & Mayer). Use of strategies is an integral part of self-regulated learning because strategies give learners better control over information processing (Winne, 2011).

One important strategy is *rehearsal*, which includes repeating information, underlining, and summarizing. Repeating information aloud, subvocally (whispering), or covertly, is an effective procedure for tasks requiring rote memorization. To learn the names of the 50 state capitols, Tim might say the name of each state followed by the name of its capital. Rehearsal also can help learners memorize lines to a song or poem and or learn English translations of foreign-language words.

Rehearsal that rotely repeats information does not link information with what one already knows. Rehearsal also does not organize information in hierarchical or other fashion. As a consequence, long-term memory does not store rehearsed information in any meaningful sense, and retrieval after some time can be difficult.

To be useful for complex learning, rehearsal must involve more than merely repeating information. *Underlining* (*highlighting*) improves learning if employed judiciously (Snowman, 1986). When too much material is underlined, underlining loses its effectiveness because less-important material is underlined along with more-important ideas. Underlined material should represent points most relevant to learning goals.

Summarizing is another popular rehearsal procedure. In summaries (oral or written), students put into their own words the main ideas expressed in the material. As with underlining, summarizing loses its effectiveness if it includes too much information (Snowman, 1986). Limiting the length of summaries forces students to identify main ideas.

A second class of learning strategies is *elaboration*, which means using imagery, mnemonics, questioning, and note taking to expand information by adding something to make learning more meaningful. *Imagery* produces a mental picture, which often is more meaningful than a verbal description. *Mnemonics* make information meaningful by relating it to what one knows. *Acronyms* are mnemonics that combine the first letters of the material to be remembered into a meaningful word; for example, "HOMES" is an acronym for the five Great Lakes (Huron, Ontario, Michigan, Erie, Superior). Sentence mnemonics use the first letters of the material to be learned as the first letters of words in a sentence (e.g., "Every Good Boy Does Fine" is a sentence mnemonic for the notes on the treble clef staff E, G, B, D, F).

Questioning requires that learners stop periodically as they read and ask themselves questions. To address higher-order learning outcomes, learners might ask "How does this information relate to what the author discussed in the preceding section?" (synthesis) or "How can this idea be applied in a school setting?" (application).

During *note taking* learners construct meaningful paraphrases of the most important ideas. While taking notes, students might integrate new material with other information in personally meaningful ways. To be effective, notes should not reflect verbatim textual information. Copying material is a form of rehearsal and may improve recall, but it is not elaboration. The intent of note taking is to integrate and apply information.

Another learning strategy is *organization*. Two useful organization techniques are outlining and mapping. *Outlining* requires that learners establish headings. One way to teach outlining is to use headings set off from the text or in the margins, along with embedded (**boldface** or *italic*) headings interspersed throughout the text. Another way is to have students identify topic sentences and points that relate to each sentence. Simply telling students to outline a passage does not facilitate learning if students do not understand the procedure.

Mapping improves learners' awareness of text structure because it involves identifying important ideas and their interrelationship. Concepts or ideas are identified, categorized, and related to one another. Mapping involves creating a hierarchy, with main ideas or superordinate concepts listed at the top, followed by supporting points, examples, and subordinate concepts. Research shows that mapping improves students' knowledge retention (Nesbit & Adescope, 2006)

Comprehension Monitoring

Theory and research show that *comprehension monitoring* (or *metacognition*) is essential for effective self-regulated learning (Dinsmore, Alexander, & Loughlin, 2008). Comprehension monitoring helps learners determine whether they are properly cognitively processing material to be learned, evaluate whether they understand the material, decide whether their strategy is effective or whether a better strategy is needed, and know why strategy use will improve learning (Weinstein & Mayer, 1986). Self-questioning, rereading, checking consistencies, and paraphrasing are monitoring processes (Baker & Brown, 1984).

Some material periodically provides students with questions about content. Students who answer these questions as they read the material are engaging in *self-questioning*. When questions are not provided, students must generate their own. Teachers can instruct students to stop periodically while reading and ask themselves questions (i.e., who, what, when, where, why, how). Using a hypermedia learning environment with middle- and high-school students, Greene and Azevedo (2009) found that monitoring activities—especially self-questioning—significantly enhanced students' understanding of complex science topics.

Rereading is often accomplished in conjunction with self-questioning; when students cannot answer questions about the text or otherwise doubt their understanding, these cues prompt them to reread. *Checking consistencies* involves determining whether parts of the material contradict others and whether conclusions drawn follow from what has been discussed. A belief that material is inconsistent also can serve as a cue for rereading to decide whether the material is inconsistent or whether the reader has failed to comprehend the content. Students who engage in *paraphrasing* material are checking their level of understanding. Being able to paraphrase means that rereading is unnecessary (Paris & Oka, 1986).

Developmental Theory

Developmental theorists conceive of self-regulation in terms of progressive cognitive changes in learners that allow them to exert greater control over their thoughts, feelings, and actions (Paris, Byrnes, & Paris, 2001). Self-regulation involves such actions as beginning and ending actions, altering the frequency and intensity of verbal and motor acts, delaying action on a goal, and acting in socially approved ways (Kopp, 1982). Researchers working within this tradition have explored developmental changes in self-regulatory processes and the key role played by private speech.

Developmental Changes in Self-Regulation

Kopp (1982) presented a framework that links behaviors and cognitive mediators with developmental phases in self-regulation. From birth to approximately three months, control is limited to states of arousal and activation of early, rudimentary behaviors (e.g., reaching). During this neurophysiological modulation stage, the important influences on behavior are maturation and parent routines (e.g., feeding) and interactions. Sensorimotor modulation occurs from 3 to 9 months, and is marked by changes in ongoing behaviors in response to events and environmental stimuli. Toward the end of the first year (9 to 12 months), the earliest form of voluntary control over behavior appears in the form of infant compliance to caregivers' requests, which depends on infants' receptivity of social behaviors and the quality of the mother-child relationship.

Impulse control appears during the second year of life (12 to 18 months); it is characterized by an awareness of social demands of situations and the initiation, maintenance, and cessation of physical acts and communications. Signs of intentionality and goal-directed actions become apparent. The second year is critical for the shifting of external to internal control of behavior (Kochanska, Tjebkes, & Forman, 1998). Parental discipline expands and child compliance is linked with internalization of rules.

The self-control phase, which emerges during the third year (24 to 36 months), is characterized by greater reactivity to adult commands and increased communicative and social interactions through the growth of language and the directive functions of speech. Internalization of adult guidance becomes increasingly prevalent. Finally, children enter a period of self-regulation during the fourth year (36 months and older). Milestones of this period are children's adoption of rules that guide their behavior, greater internalization of guidance by others, emergence of cognitive mediation of behavior (e.g., thought processes), and adaptation of behavior to changes in environmental demands.

Over the past several years, information processing has gained priority in the psychological study of human development (Samuelson & Smith, 2000). Attention, encoding, retrieval, and metacognition improve with development, along with the speed with which children execute these cognitive processes (Kail & Ferrer, 2007).

Sustained attention is difficult for young children, as is attending to relevant rather than irrelevant information. Children also have difficulty switching attention rapidly from one activity to another. The ability to control attention contributes to the improvement of working (short-term) memory, or the memory of immediate consciousness (Swanson, 2008). It behooves teachers to forewarn students of the attentional demands required to learn. Outlines and study guides can serve as advance organizers and cue learners about the types of information that will be important. While students are working, teachers can use prompts, questions, and feedback to help students remain focused on important task aspects (Meece, 2002).

A simple way to assess children's information processing is with a *digit-span task.* In this task, a researcher reads a series of digits (e.g., 5–3–8–10–2–9) to a child at a rate of one digit per second, and when the researcher finishes, the child attempts to repeat the sequence. An average 5-year-old can repeat four digits accurately; this increases to six or seven by age 12 (Meece, 2002).

Underlying this developmental improvement are information processing capacities and cognitive processes (Matlin, 2009). In all likelihood these interact: As information processing capacity expands, better cognitive processes can be applied. For example, as children's capacities for attention, encoding, and storage increase, those who employ better strategies for attending, rehearsing, organizing, and retrieving demonstrate enhanced cognitive development.

Most of a child's basic cognitive processes are well in place by early childhood. From this point onward, developmental changes primarily involve learning how to make better and more efficient use of existing perceptual and attentional processes. Some of the more important changes include the ability to make fine discriminations between stimulus objects, the development of automaticity and selective attention, and the ability to exert control over attention (Meece, 2002).

Automaticity is an important function. Automatic attention means that children gradually eliminate attention as an active cognitive process. When attention becomes automatic, less cognitive effort is needed in the early stages of information processing, and thus children can put forth effort where it is needed. Thus, as decoding becomes automatic, more cognitive processing can be shifted to comprehension. Poor readers, for whom decoding is not automatic, expend much effort to decode, with the result that their comprehension suffers.

Children also improve in their knowledge and use of encoding strategies (Matlin, 2009). Rehearsal appears early and improves as children become older (Flavell, 1999). In other areas such as organization and elaboration, children's use of strategies improves with age. These strategies can be taught and enhance children's memory and understanding (Meece, 2002).

With respect to retrieval, older children use better strategies than younger ones (Flavell, 1999). For example, older children are more likely to conduct an exhaustive memory search and not quit when the needed information does not come to mind immediately. Older children also have learned different ways to access information, such as by thinking about different situations where that information may be useful. Although strategy change often occurs slowly in children, they are likely to adopt new strategies when these lead to consistently more-accurate solutions than their present strategies (Siegler & Svetina, 2006).

Metacognitive understanding expands greatly between the ages of 5 and 10 (Flavell, 1999). Metacognitive improvements are a hallmark of development as children acquire methods for monitoring their level of understanding, asking themselves questions about what they have read, and summarizing information (Dinsmore et al., 2008). They learn what strategies to use for different tasks, and with development they are more likely to believe that strategy use leads to better performance.

Children's metacognitive awareness develops gradually. Alexander, Carr, and Schwanenflugel (1995) found that steady developmental improvements occurred in metacognitive knowledge, as well as in the metacognitive skills of self-monitoring and self-regulation of strategy use. As noted earlier, self-monitoring of performance is aided with self-recording, such as with diaries and checklists that contain essential aspects of the task (Zimmerman, Bonner, & Kovach, 1996). For example, if students are engaged in reading comprehension, the checklist can contain steps such as reading the passage, determining the main characters, and deciding on the main action.

Private Speech

Cognitive developmental theory establishes a strong link between private speech and the development of self-regulation (Berk, 1986). *Private speech* refers to the set of speech phenomena that has a self-regulatory function but is not socially communicative (Fuson, 1979). The historical impetus derives in part from work by Pavlov (1927), who distinguished the first (perceptual) from the second (linguistic) signal systems. Pavlov believed that conditioning differences between humans and animals were due to the human capacity for language and thought. Stimuli may not produce conditioning automatically; people interpret stimuli in light of their prior experiences. Although Pavlov did not conduct research on the second signal system, subsequent investigations have validated his beliefs that human conditioning is complex and language plays a mediational role.

Luria (1961) focused on the child's transition from the first to the second signal system. Luria postulated three stages in the development of verbal control of motor behavior. Initially, the speech of others directs the child's behavior (ages 1½ to 2½). During the second stage (ages 3 to 4), the child's overt verbalizations initiated motor behaviors but do not necessarily inhibit them. In the third stage, the child's private speech becomes capable of initiating, directing, and inhibiting motor behaviors (ages

4½ to 5½). Luria believed this private, self-regulatory speech directed behavior through neurophysiological mechanisms. The mediational and self-directing role of the second signal system is embodied in Vygotsky's social constructivist theory (discussed later).

Many investigations have attempted to determine what factors determine why children do not use private speech when doing so would be desirable. A distinction is drawn between production and mediational deficiencies in spontaneous use of private speech. A *production deficiency* is a failure to generate task-relevant verbalizations (e.g., rules, strategies, information to be remembered) when they could improve performance. A *mediational deficiency* occurs when task-relevant verbalizations are produced but they do not affect subsequent behaviors (Fuson, 1979).

Young children produce verbalizations that do not necessarily mediate performance. Children eventually develop the ability to verbalize statements that mediate performance, but they may not produce relevant verbalizations at the appropriate times. With development, children learn to verbalize when it might benefit their performances. This developmental model fits better in situations calling for simple types of verbal self-regulation (e.g., rote rehearsal) than when complex verbalizations are required. For the latter, production and mediational deficiencies may coexist and may not follow a simple progression (Fuson, 1979).

Ample research demonstrates that once children are trained to produce verbalizations to aid performance, they often discontinue use of private speech when no longer required to verbalize (Schunk, 1982). This *continued-use deficiency* arises when students have an inadequate understanding of the strategy, as they might when they receive insufficient instruction and practice using the strategy. Teachers can remedy this problem by providing repeated instruction and practice with spaced review sessions. A continued-use deficiency also might arise when students associate the strategy with the training context and do not understand how to transfer it to other tasks. Use of multiple tasks during training helps students understand uses of the strategy. Strategies often must be modified to apply to different tasks. When slight modifications prove troublesome, students benefit from explicit training on strategy modification.

Continued-use deficiencies can also occur when learners do not understand that use of private speech benefits their performances. They might believe that verbal self-regulation is useful, but that it is not as important for success as such factors as personal effort or time available (Fabricius & Hagen, 1984). To promote maintenance of verbal self-regulators, researchers suggest providing learners with information that links strategy use with improved performance (Baker & Brown, 1984; Schunk & Rice, 1987).

Strategy value can be conveyed by instructing students to use the strategy because it will help them perform better, informing them that strategy use benefited other students, and providing feedback linking strategy use with progress in skill acquisition. Research shows that strategy value information enhances performance, continued strategy use, and strategy transfer to other tasks (Lodico, Ghatala, Levin, Pressley, & Bell, 1983; Paris, Newman, & McVey, 1982).

Social Constructivist Theory

Social constructivist perspectives on self-regulation are grounded in theories of cognitive development. These perspectives reflect certain core assumptions about self-regulation (Paris & Byrnes, 1989; Paris et al., 2001).

Assumptions

Constructivists assume that people are intrinsically motivated to learn. From birth onward, people are motivated to actively explore, understand, and control their environments. Understanding transcends the literal information acquired. People impose meaning on their perceptions and form beliefs according to their prior experiences.

Constructivists also assume that individuals' mental representations change with development. Infants and toddlers represent their worlds in terms of actions and visual images. With development, learners use the tools of their cultures (e.g., languages, symbols) to represent what they know.

Another constructivist assumption is that there are progressive refinements in levels of understanding. The process of reconciling what one knows and what one encounters never ends. Progressive refinements are stimulated by internal reorganizations and reflections, as well as by physical experiences, social guidance, and exposure to new information.

Constructivists believe that development places limits on learning. Readiness for learning includes maturation and prior experiences. Learning proceeds best when learners have the potential to learn and are exposed to information commensurate with their readiness.

Finally, reflection and reconstruction stimulate learning. Although formal teaching methods can produce learning, the primary motivation behind learning comes from within learners and involves an intrinsic need to reexamine one's knowledge and behaviors. Learners construct theories about what they are able to do and why.

Construction of Theories

Social constructivists view self-regulation as the process of acquiring beliefs about and forming theories of one's abilities and competencies, the structure and difficulty of learning tasks, and the way to regulate effort and strategy use to accomplish goals (Paris & Byrnes, 1989; Paris et al., 2001). These theories and beliefs are constrained by development and change as a consequence of development and experience.

For example, research shows that children's earliest *attributions* (perceived causes of outcomes) are nondifferentiated but that with development a distinct conception of ability emerges (Nicholls, 1978). Once this differentiation occurs, children realize that performance may not match abilities and that other factors (e.g., effort, help from others) influence performance. Children's theories about the causes of academic outcomes reflect this developmental progression (Buehl & Alexander, 2009; Graham & Williams, 2009).

In like fashion, researchers have shown how children construct theories about the use and value of strategies. Children are taught methods to use on different tasks, and construct their own versions of what works best for them. Strategy information includes the strategy's goals, the tasks for which it is appropriate, how it improves performance, and how much effort it requires to use (Borkowski, Johnston, & Reid, 1987). Although strategies typically are task specific, there are general strategies such as goal setting and evaluation of progress that apply to varied tasks (Pressley et al., 1990; Zimmerman, 2011).

It often happens that learners construct theories erroneously because their constructions are based on incomplete information. In mathematics, for example, students often use erroneous strategies that lead to inaccurate solutions (*buggy algorithms*; Brown & Burton, 1978). In subtraction, children may acquire the belief that in each column they subtract the smaller number from the larger number regardless of whether that means they move from top to bottom or from bottom to top. This buggy algorithm generates solutions and can lead to a false sense of self-efficacy (perceived capabilities) for subtraction, which yields gross mismatches between what children believe they can do and their actual skills.

Research by Dweck and her colleagues has shown that individuals develop *mindsets*, or theories about themselves that reflect their capabilities and capacities for learning (Dweck, 2006). Persons holding a *fixed mindset* believe that what they can learn is limited and that no amount of effort or assistance can overcome that limit. Conversely, those holding a *growth mindset* believe that they are capable of continuing to improve their skills. Mindsets can affect learning, motivation, and self-regulation; learners with growth mindsets are apt to engage more productively in learning and persevere in the face of obstacles (Dweck, 2006).

Learners' theories about themselves are constructed partly through direct instruction from others (e.g., teachers, peers, parents), but also largely through their personal reflections on their performances, environmental effects, and responses from others. Theories are constructed using the tools (i.e., language, signs, symbols) of the culture, and in social contexts in the zone of proximal development (discussed in the next section).

The goal is for students to construct a self-identity as students. Their beliefs are influenced by others and may include stereotypes associated with gender, culture, and ethnic background (Graham & Williams, 2009). Paris et al. (2001) contended that the separation of identity development and self-regulated learning is impossible because achievement behaviors are indicators of who students believe they are or who they want to become. Strategies cannot be taught independently of goals, roles, and identities of students. In other words, self-regulation is intimately linked with personal development.

Children are intrinsically motivated to construct explanatory frameworks and understand their educational experiences (Paris et al., 2001). When they are successful, they construct theories of competence, tasks, and themselves, which aid learning and use of adaptive learning strategies. But when they are unsuccessful, they may construct inappropriate goals and strategies. In short, self-regulation is heavily dependent on how children perceive themselves and achievement tasks (Dweck & Master, 2008).

Vygotsky's Theory

The Russian psychologist Vygotsky's work is relevant to the social constructivist tradition. Vygotsky emphasized the role that language plays in self-regulation (Tudge & Scrimsher, 2003). Vygotsky (1962) believed that private speech helped to develop thought by organizing behavior. Children employed private speech to understand situations and surmount difficulties. Private speech occurred in conjunction with children's interactions in the social environment. As children's language facility developed, words spoken by others acquired meaning independent of their phonological and syntactical qualities. Children internalized word meanings and used them to direct their behaviors.

Vygotsky (1962) hypothesized that private speech followed a curvilinear developmental pattern: Overt verbalization (thinking aloud) increases until ages 6 to 7, after which it declines and becomes primarily covert (internal) by ages 8 to 10. However, overt verbalization could occur at any age when people encounter problems or difficulties. Research shows that although the amount of private speech decreases from about ages 4 or 5 to 8, the proportion of private speech that is self-regulating increases with age (Fuson, 1979). In many research investigations, the actual amount of private speech is small, and many children do not verbalize at all. Thus, the developmental pattern of private speech seems more complex than originally hypothesized by Vygotsky.

Another Vygotskian concept is the *zone of proximal development*, or the amount of learning possible by a student given the proper instructional conditions (Tudge & Scrimsher, 2003). Tasks that a student cannot do alone but can do with some assistance fall into the zone. As teachers or peers provide *scaffolding* to assist learners, they are increasingly able to operate independently as they internalize their learning. Eventually the zone is changed to reflect new, higher-order learning. Self-regulation thus involves internalizing skills and beliefs such that learners can interact in new learning situations on their own.

Social Cognitive Theory

The principles of social cognitive theory have been applied extensively to self-regulation (Bandura, 1997, 2001; Pintrich, 2004; Pintrich & Zusho, 2002; Zimmerman, 2000; Zimmerman & Schunk, 2004). From a social cognitive perspective, self-regulation involves learner choices as captured in Zimmerman's (1998) conceptual framework comprising six areas that one can self-regulate: motives, methods, time, outcomes, physical environment, social environment. Self-regulation is possible to the extent that learners have choices in one or more of these areas. When all aspects of a task are predetermined, students may learn but the source of control is external (i.e., teachers, parents, computers).

Reciprocal Interactions

Bandura's (1986) social cognitive theory serves as the conceptual framework for social cognitive perspectives on self-regulation. According to Bandura (1986), human functioning involves reciprocal interactions between personal, behavioral, and social/environmental factors (Figure 3.1). This reciprocity is exemplified with an important construct in Bandura's theory: *perceive self-efficacy*, or beliefs about one's capabilities to learn or perform behaviors at designated levels (Bandura, 1997). Research shows that students' self-efficacy beliefs influence such actions as choice of tasks, persistence, effort, and achievement (Schunk & Pajares, 2009). In turn, students' behaviors modify their efficacy beliefs. For example, as students work on tasks they note their progress toward their learning goals (e.g., completing sections of a term paper). Progress indicators convey to students that they are capable of performing well, which enhances self-efficacy for continued learning.

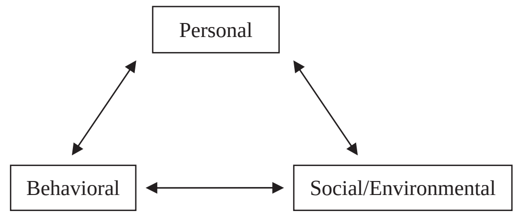


Figure 3.1 Reciprocal interactions in social cognitive theory

The interaction between self-efficacy and social/environmental factors has been demonstrated in research on students with learning disabilities, many of whom hold low self-efficacy for performing well (Licht & Kistner, 1986). Individuals in students' social environments may react to them based on attributes typically associated with them rather than on what students actually do. Teachers may judge such students as less capable than average learners and hold lower academic expectations for them, even in content areas where students with learning disabilities are performing adequately. In turn, teacher feedback can affect self-efficacy. Persuasive statements (e.g., "I know that you can do this") can raise self-efficacy.

Students' behaviors and classroom environments influence one another. In a typical instructional sequence, a teacher presents information and may ask students to direct their attention to a visual. Environmental influence on behavior occurs when students attend to the visual without much conscious deliberation. Students' behaviors often alter the instructional environment. If the teacher asks questions and students give incorrect answers, the teacher may reteach some points rather than continue the lesson.

Processes of Self-Regulated Learning

The classical social cognitive view of self-regulation conceptualized it as involving three key processes: self-observation, self-judgment, self-reaction (Bandura, 1986; Kanfer & Gaelick, 1986). These processes are not mutually exclusive but rather interact. While observing aspects of one's behavior, one may judge them against standards and react positively or negatively. One's evaluations and reactions set the stage for additional observations of the same behavioral aspects or others. These processes also do not operate independently of the learning environment; environmental factors can assist the development of self-regulation. Only the latter two processes are discussed here because self-observation is substantially similar to self-monitoring (described earlier; Harris et al., 2011; Zimmerman, 2011).

Self-judgment refers to comparing present performance with one's goal. The belief that one is making goal progress enhances self-efficacy and sustains motivation. Students who find a task to be easy may think that they set their goal too low and may set it higher the next time. Further, knowing that similar others performed a task can promote self-efficacy and motivation; students are apt to believe that if others can succeed they can as well (Schunk & Pajares, 2009). Students who believe they have not made acceptable progress will not become discouraged if they feel efficacious about succeeding and believe that a different strategy will produce better results.

Self-reactions to goal progress exert motivational effects (Bandura, 1986). Students who judge goal progress as acceptable and anticipate satisfaction from goal accomplishment will feel efficacious about continuing to improve and motivated to complete the task. Negative evaluations will not necessarily decrease motivation if students believe they are capable of improving, such as by working harder. Motivation will not increase if students believe they lack the ability to succeed or to improve.

Instructions to people to respond evaluatively to their performances can affect motivation. People who believe they can perform better persist longer and work harder (Kanfer & Gaelick, 1986). Evaluations are not intimately tied to level of performance. Some students are content with a B in a course, whereas others want only an A. Assuming that people believe they are capable of improving, higher goals lead to greater effort and persistence than do lower goals (Locke & Latham, 2002).

Cyclical Nature of Self-Regulation

The interaction of personal, behavioral, and social/environmental factors during self-regulation is a cyclical process because these factors typically change during learning and must be monitored (Bandura, 1986, 1997; Zimmerman, 2000, 2011). Such monitoring leads to changes in an individual's strategies, cognitions, affects, and behaviors.

This cyclical nature is captured in Zimmerman's (2000) three-phase self-regulation model. This model also expands the classical view, which covers during and after task engagement, because it also includes self-regulatory processes performed before task engagement. The *forethought* phase precedes actual performance and refers to processes that set the stage for action. The *performance (volitional) control* phase involves processes that occur during learning and affect attention and action. During the *self-reflection* phase—which occurs after performance and during pauses—people respond evaluatively to their efforts. Similar types of phases and processes are evident in other self-regulation models. Lord et al. (2010) identified four goal-related processes that occur during a feedback loop: goal establishment, planning, action, and evaluation and feedback. Pintrich (2000) postulated the phases of forethought/planning/activation, monitoring, control, and reaction/reflection.

Various self-regulatory processes come into play during the different phases (Zimmerman, 2011). In the forethought phase, learners set goals, engage in strategic planning, and hold a sense of self-efficacy for learning and attaining their goals. Performance control involves implementing learning strategies that affect motivation and learning, as well as monitoring and recording one's performances. During periods of self-reflection, learners evaluate their goal progress, make attributions for their outcomes, decide whether to continue or alter their strategies, and set new goals as needed.

Research supports the validity of these three phases and substantiates the hypothesized processes that occur during them. DiBenedetto and Zimmerman (2010) studied the self-regulation processes of high school students who were high, average, or low achievers in science. Compared with students who were average- or low-achieving, high achievers employed more self-regulatory processes during each of the three phases, spent more time studying science, and displayed higher achievement.

Teaching students to engage in self-regulation in all three phases has desirable effects on *motivation* and performance (Cleary, Zimmerman, & Keating, 2006). Cleary et al. taught free-throw shooting to college students who were novice basketball players. All students received instruction on the basics of how to shoot free throws. Students then received instruction in self-regulation for one, two, or three phases, after which they practiced shooting free throws. The one-phase (forethought) group was taught to set goals. Students in the two-phase (forethought, performance control) group set goals and self-recorded performance. Those in the three-phase (forethought, performance control, self-reflection) group set goals, self-recorded performance, and made attributions and adjustments in their strategies following missed free throws. Students in the three-phase group displayed the most-adaptive attributions and strategy corrections; those in the two- and three-phase groups demonstrated the most-accurate shooting.

Social to Self-Progression

Schunk and Zimmerman (1997) postulated that self-regulation develops initially from social sources and shifts to self-sources in a series of levels. At the outset, novice learners acquire learning strategies most rapidly from teaching, social modeling, task structuring, and encouragement (Zimmerman, 2000). At this *observation* level, learners can induce the major features of learning strategies from observing models; however, most of them also need practice to fully incorporate the skill into their behavioral repertoires. Accuracy can be improved if models provide guidance, feedback, and social reinforcement during practice. During participant (mastery) modeling (Bandura, 1986), models repeat aspects of the strategy and guide enactment based on learners' imitative accuracy.

Learners attain an *emulation* level of skill when their performances approximate the general form of the model's. Observers are not copying the model but rather they imitate general patterns or styles. For example, they may imitate the type of question that the model asks but not mimic the model's words.

The source of learning skills is primarily social (external) for the first two levels but shifts to self (internal) influences at more advanced levels as learners internalize skills and self-regulatory processes. The third, *self-control* level, is characterized by learners' ability to use strategies independently while performing transfer tasks. Students' use of strategies becomes internalized but is affected by representational standards of modeled performances (e.g., covert images and verbal meanings) and self-reinforcement processes (Bandura, 1986).

When students reach a *self-regulation* level of academic skill, they can systematically adapt strategies to changes in personal and situational conditions (Bandura, 1986). At this level, learners initiate use of strategies, incorporate adjustments based on features of situations, and are motivated to achieve by goals and perceptions of self-efficacy. Learners choose when to use particular strategies and adapt them to changing conditions with little or no guidance from models.

Reciprocal interactions are evident throughout the phases. Social factors in the environment influence behaviors and personal factors, which in turn affect the social environment. In the early stages of learning, teachers who observe problems in learners' performances offer correction, learners who do not fully comprehend how to perform a skill or strategy at the emulation level may ask teachers for assistance, and learners' performances affect their self-efficacy. More-advanced learners mentally and overtly practice skills and seek out teachers, coaches, and tutors, to help refine their skills.

Social influences do not disappear with advancing skill acquisition. Although learners at the self-control and self-regulation phases use social sources less frequently, they nonetheless continue to rely on them (Zimmerman, 2000). Self-regulation does not mean social independence but rather increasing internalization and self-direction of one's learning. Social cognitive theory contends that it is possible to learn on one's own, but self-teaching does not fully capitalize on the benefits of the social environment on learning. Furthermore, failing to use the social environment may limit overall skill acquisition unless learners possess good self-regulatory skills.

SELF-REGULATION RESEARCH

This section reviews some key areas of research on self-regulation in academic settings. A comprehensive review is beyond the scope of this chapter; readers are advised to refer to other sources (Bandura, 1986, 1997; Boekaerts, Pintrich, & Zeidner, 2000; Schunk & Zimmerman, 2008; Zimmerman & Schunk, 2011). Initially, we review research that sought to identify effective self-regulatory processes, after which we discuss research exploring the relation of these processes to one another and to achievement outcomes.

Effective Self-Regulatory Processes

Researchers have investigated the types of self-regulatory processes that students use while engaged in academic learning. Some of these research studies also have determined whether students' use of processes varies as a function of individual difference variables.

Zimmerman and Martinez-Pons (1986) developed a structured interview in which students were presented with eight different learning contexts (e.g., writing a short paper, taking a test, completing a homework assignment). For each, they were asked to state the methods they would use. Fourteen categories of self-regulated learning processes were identified (Table 3.2).

In subsequent research, Zimmerman and Martinez-Pons (1990) found evidence of developmental trends

TABLE 3.2 Categories of Self-Regulated Learning Processes

Category	Example
Self-evaluating	Checking work to ensure it is correct
Organizing and transforming	Making an outline before writing
Goal-setting and planning	Start studying 2 weeks before a test
Seeking information	Do library research before writing a paper
Keeping records and monitoring	Keep a list of words missed
Environmental structuring	Isolate oneself from distractions
Self-consequating	Reward oneself after a high test score
Rehearsing and memorizing	Write down formulas until they are learned
Seeking peer assistance	Ask a friend how to do an assignment
Seeking teacher assistance	Ask the teacher to re-explain a concept
Seeking adult assistance	Ask a parent to check homework
Reviewing tests	Determine correct answers on items missed
Reviewing notes	Study notes prior to a test
Reviewing texts	Study text prior to a test

among 5th, 8th, and 11th graders. Compared with younger children, older students reviewed notes more and texts less, sought more assistance from teachers and less from parents, and displayed greater use of keeping records and monitoring, organizing and transforming, and goal setting and planning. The researchers found that, compared with boys, girls made greater use of keeping records and monitoring, environmental structuring, and goal setting and planning. Relative to nongifted students, gifted learners displayed greater organizing and transforming, self-consequating, reviewing notes, seeking peer assistance, and (fifth grade only) seeking adult assistance.

Various aspects of self-regulation were addressed by Pintrich and De Groot (1990). Seventh graders were administered the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993). This instrument includes two categories: motivational beliefs (self-efficacy, intrinsic value, test anxiety) and self-regulated learning strategies (cognitive strategy use, self-regulation). Sample items tapping motivational beliefs are, "Compared with other students in this class I expect to do well," and, "I think I will be able to use what I learn in this class in other classes"; for self-regulation, "When I study I put important ideas into my own words," and, "I ask myself questions to make sure I know the material I have been studying." Although the authors distinguished motivational beliefs from self-regulated strategies, establishing and maintaining positive beliefs about learning is an effective self-regulatory strategy (Zimmerman, 2011). The MSLQ categories show some overlap with those identified by Zimmerman and Martinez-Pons (1986) and by Weinstein and Mayer (1986).

Operation of Self-Regulatory Processes During Learning

Goals

Goals are integral to self-regulation, and goal setting is a key component of the forethought phase (Zimmerman, 2011). Researchers have investigated how the properties of goals affect learning, motivation, and self-regulation (Locke & Latham, 2002). In an early study, Bandura and Schunk (1981) tested the idea that proximal (short-term) goals enhance achievement outcomes better than distant (long-term) goals. Children received subtraction instruction and self-regulated problem solving over sessions. Some set a proximal goal of completing one set of materials each session; others pursued a distant goal of completing all sets of materials by the end of the last session; a third group was advised to work productively (general goal). Proximal goals led to the most productive self-regulated practice and to the highest subtraction self-efficacy and achievement; the distant goal resulted in no benefits compared with the general goal.

Schunk (1983a) tested the effects of the goal property of difficulty. During a long division instructional program, children received either difficult but attainable or easier goals of completing a given number of problems each session. Within each goal condition, children either were given direct attainment information by an adult (i.e., "You can do this") or received information indicating that other similar children had completed that many problems. Difficult goals enhanced motivation during self-regulated practice and achievement; direct goal attainment information promoted self-efficacy.

Schunk and Swartz (1993) investigated how goals and progress feedback affected achievement outcomes and self-regulation. Children received instruction on writing different types of paragraphs, along with self-directed practice over sessions. An adult modeled a writing strategy, after which children practiced applying it to compose paragraphs. Process (learning) goal children were told to learn to use the strategy; product (performance) goal children were advised to write paragraphs; general goal students were told to do their best. Half of the process goal students periodically received progress feedback that linked strategy use with improved performance.

The process goal plus feedback condition was the most effective and some benefits were obtained from the process goal alone. Process goal plus feedback students outperformed product and general goal students on self-efficacy, writing achievement, self-evaluated learning progress, and self-regulated strategy use. Gains were maintained after 6 weeks; children applied self-regulated composing strategies to types of paragraphs on which they had received no instruction.

Zimmerman and Kitsantas (1996, 1997) found that providing process goals (similar to learning goals) raised self-efficacy and self-regulation during dart throwing. Ninth and tenth-grade girls were assigned to a process-goal condition and advised to focus on the steps in dart throwing. Others were assigned to a product (performance) goal condition and told to concentrate on their scores. Some girls engaged in self-monitoring by writing down after each throw either the steps they accomplished properly or their throw's outcome.

In the first study (Zimmerman & Kitsantas, 1996), process-goal girls attained higher self-efficacy and performance than did product-goal girls. Self-recording also enhanced these outcomes. The second study replicated these results (Zimmerman & Kitsantas, 1997); however, a shifting-goal condition was included where girls pursued a process goal but once they could perform the steps automatically they switched to a product goal of attaining high scores. The shifting goal led to the highest self-efficacy and performance.

Social Modeling

Modeling studies provide evidence on how information conveyed socially can be internalized by students and used self-regulatively to produce greater learning. In addition to their benefits on learning, models convey that observers can succeed if they follow the same sequence. Students who believe they know how to perform a skill or strategy feel efficacious and motivated to succeed (Schunk & Pajares, 2009).

An important means of acquiring self-evaluative standards is through observation of models. When children observe modeled standards they are more likely to adopt them, and model similarity can increase adoption of standards. Zimmerman and Ringle (1981) found that models affected children's self-efficacy and achievement behaviors. Children observed an adult model unsuccessfully try to solve a wire-puzzle problem for a long or short period; the model also verbalized statements of confidence or pessimism. Children who observed a pessimistic model persist for a long time lowered their self-efficacy judgments for performing well.

Brown and Inouye (1978) obtained similar results with college students who judged self-efficacy for solving anagrams, attempted to solve them, and were informed that they performed better than or the same as a model. Participants then observed the model fail to solve anagrams, after which they again judged self-efficacy and solved anagrams. Telling students that they were more competent than the model resulted in higher self-efficacy and persistence than telling them they were equally competent.

Schunk (1981) provided children with either adult modeling or written instruction on mathematical division, followed by guided and self-directed practice, over sessions. The adult model verbalized division solution steps while applying them to problems, Both treatments enhanced self-efficacy, persistence, and achievement, but modeling led to higher achievement and more accurate correspondence between self-efficacy and actual performance. Path analysis showed that modeling enhanced self-efficacy and achievement, self-efficacy directly affected persistence and achievement, and persistence raised achievement.

Researchers have investigated the role of perceived similarity in competence by comparing mastery with coping models. Coping models initially demonstrate difficulty learning but gradually improve and gain confidence. They illustrate how effort and positive thoughts can overcome obstacles. In addition to the modeled skills and strategies, observers learn and internalize these motivational beliefs and self-regulatory actions. In contrast, mastery models demonstrate competent performance throughout the modeled sequence. In the early stages of learning, many students may perceive themselves more similar in competence to coping models.

Schunk and Hanson (1985) had children observe models solving subtraction problems. Peer mastery models solved subtraction problems correctly and verbalized statements reflecting high efficacy and ability, low task difficulty, and positive attitudes. Peer coping models initially made errors and verbalized negative statements, but then verbalized coping statements and eventually verbalized and performed as well as mastery models. After observing a peer mastery, peer coping, adult mastery, or no model, children received instruction and self-regulated practice over sessions. Peer mastery and coping models increased self-efficacy and achievement better than adult and no models; adult-model children outperformed no-model students.

Schunk, Hanson, and Cox (1987) further explored mastery-coping differences and found that observing peer coping models enhanced children's self-efficacy and achievement more than did observing peer mastery models. Unlike the Schunk and Hanson (1985) study, this project used fractions—a task at which children previously had not been successful. Coping models may be more effective when students have little task familiarity or have had previous learning difficulties. Schunk et al. also found that multiple peer coping or mastery models promoted outcomes as well as a single coping model and better than a single mastery model. With multiple models, learners are apt to perceive themselves as similar to at least one model.

Schunk and Hanson (1989) investigated *self-modeling*, or cognitive and behavioral changes brought about by observing one's own performances (Dowrick, 1999). Children were videotaped while solving mathematical problems and then observed their tapes, after which they engaged in self-regulated practice. These children displayed higher self-efficacy, motivation, and self-regulated strategy use than did children who had been taped but did not observe their tapes and children who had not been taped.

Research by Zimmerman and Kitsantas (1997, 2002) illustrates the operation of self-regulation development phases (observation, emulation, self-control, self-regulation). Zimmerman and Kitsantas (2002) taught college undergraduates writing revision skills. At the observation level, participants observed while the experimenter demonstrated applying the revision strategy to several exercises, each of which included 6 to 10 kernel sentences that were to be combined into nonrepetitive sentences. The observation level was varied for participants depending on their experimental condition. Some observed a mastery model, where the experimenter skillfully worked all revision exercises; others observed a coping model, where the experimenter initially made errors but corrected them and gradually improved to the point of the mastery model. The emulation level in this study was defined as participants applying the strategy to revision exercises; depending on their experimental condition, some participants received encouragement and feedback while revising whereas others did not. Observing a coping model led to higher writing skill and self-efficacy than did observing a mastery model; the latter students outperformed those not exposed to a model. Regardless of condition, providing encouragement and feedback promoted skills and self-efficacy.

The shift from the self-control to the self-regulation level was addressed in the Zimmerman and Kitsantas (1997) study summarized earlier. After receiving explanation and modeled demonstration of the task (observation), participants practiced throwing darts (emulation). Some participants received a process goal of performing the actions properly, whereas others received an outcome goal of attaining a given score. The self-control level was defined as the consistent throwing of darts using the prescribed strategic steps. The shifting-goal condition was designed to facilitate self-regulation as participants had to adapt their strategy to attain the desired score. The self-regulation level was operationally defined as a change from following a specific strategy to adapting the strategy on one's own. Such adaptation helps students internalize self-regulatory processes, which is a critical element in a social-to-self (external-to-internal) progression of skill development and necessary for self-regulated skill improvement over time and beyond the initial learning settings (Schunk & Zimmerman, 1997). Internalization begins with learners at the observation and emulation levels, increases with the shift to the self-control level, and becomes established at the self-regulation level.

Strategy Use and Self-Verbalization

Learners' verbalizations of self-regulatory strategies can guide their learning during the performance control phase. Schunk (1982) provided modeled instruction on long division and self-directed practice to children with low mathematical achievement. Adult models verbalized strategy descriptors (e.g., "multiply," "check") at appropriate places. During self-directed practice, some children verbalized the descriptors, others constructed their own verbalizations, those in a third group overtly verbalized strategies and self-constructions, and children in a fourth group did not verbalize. Self-constructed verbalizations yielded the highest self-directed practice and mathematical achievement. Children who verbalized strategies and self-constructions judged self-efficacy the highest. Self-constructions typically included the strategies and were oriented toward successful problem solving.

Schunk and Cox (1986) examined the role of verbalization during learning of subtraction problem solution strategies among children with learning disabilities. While solving problems, continuous-verbalization students verbalized aloud problem-solving operations. Midway through the instructional program, discontinued-verbalization children were asked to no longer verbalize aloud. No-verbalization children did not verbalize aloud.

Continuous verbalization led to the highest self-efficacy and achievement. When instructed to discontinue verbalizing aloud, these students may have not continued to use the verbal mediators to regulate their academic performances. For verbal mediators to become internalized, students may need to be taught to fade overt verbalizations to a covert level.

Progress Feedback and Self-Evaluation

As learners pursue goals it is important that they believe they are making progress. During periods of self-reflection learners can evaluate their progress when tasks have clear criteria; however, on many tasks it is difficult to determine goal progress, especially when standards are not clear or progress is slow. Feedback indicating progress can substantiate self-efficacy and motivation. As learners become more skillful, they become better at self-evaluating progress.

Schunk (1996) investigated how goals and self-evaluation affected self-regulated learning and achievement outcomes. Children received instruction and self-directed practice on fractions over sessions. Students worked under conditions involving either a goal of learning how to solve problems or a goal of merely solving them. Half of the students in each goal condition evaluated their problem-solving capabilities after each session. The learning goal with or without self-evaluation and the performance goal with self-evaluation led to higher self-efficacy, skill, and motivation, than did the performance goal without self-evaluation. In a second study, all students in each goal condition evaluated their progress once. The learning goal led to higher motivation and achievement outcomes than did the performance goal.

Frequent opportunities for self-evaluation of capabilities or progress raised achievement outcomes regardless of whether students received learning or performance goals. Conversely, infrequent opportunities for self-evaluation promoted self-regulated learning and self-efficacy only among students receiving learning goals. Under these conditions, self-evaluation may complement learning goals better than performance goals.

Schunk and Ertmer (1999) replicated these results with college students during instruction on computer skills. When opportunities for self-evaluation were minimal, the learning goal led to higher self-efficacy, self-evaluated learning progress, and self-regulatory competence and strategy use; self-evaluation promoted self-efficacy. Conversely, frequent self-evaluation produced comparable outcomes when coupled with a learning or performance goal.

Self-Monitoring

The effects of self-monitoring have been studied extensively (Mace et al., 1989; Zimmerman et al., 1996). In an early study (Sagotsky, Patterson, & Lepper, 1978), fifth- and sixth-grade students periodically monitored their work during mathematics sessions and recorded whether they were working on appropriate materials. Other students set daily performance goals, and students in a third condition received self-monitoring and goal setting. Self-monitoring significantly increased students' time on task and mathematical achievement; goal setting had minimal effects. The authors suggested that children may have needed training on how to set challenging but attainable goals.

Schunk (1983b) found benefits of monitoring with children during mathematics learning. Self-monitoring students recorded their progress at the end of each session; external monitoring students had their progress recorded by an adult; no-monitoring students were not monitored and did not self-monitor. Self- and external monitoring enhanced self-efficacy and achievement equally well and better than did no monitoring. Effects of monitoring did not depend on session performance because the three conditions did not differ in work completed during self-directed practice. The key was monitoring of progress rather than who performed it.

INTERVENTIONS TO ENHANCE SELF-REGULATION

Self-regulation does not develop automatically with maturation nor is it acquired passively from the environment. Systematic interventions assist the development and acquisition of self-regulatory skills. In this section we describe two intervention projects designed to enhance students' self-regulation and achievement. These projects were selected because they included several of the self-regulation processes discussed in this chapter, involved different types of participants (children, adults), and addressed two content areas (writing, mathematics).

Self-Regulated Strategy Development

Self-Regulated Strategy Development (SRSD) is an intervention program designed to teach students strategies for successfully completing academic tasks (Harris, Graham, & Mason, 2006). It includes instruction and practice on self-regulation strategies (e.g., goal setting, self-monitoring, effort expenditure) designed to improve academic performance and motivation. This model utilizes teacher modeling of strategies, collaborative peer group practice, and independent practice, where assistance (*scaffolding*) is gradually faded out. The model includes general and specific strategies, as well as motivational components (e.g., self-reinforcement).

The SRSD model has been applied to different academic content including writing (Harris et al., 2006), reading (Mason, 2004), and mathematics (Fuchs et al., 2003). Research has shown that SRSD has a positive effect on students' learning, motivation, and self-regulated strategy use (Harris et al., 2006). Described in this section is its application to writing; some adaptations of the procedure typically are necessary depending on the type of students, content area, and specific skills addressed.

Reid and Lienemann (2006) used the SRSD model with elementary school children identified as having attention deficit/hyperactivity disorder. The specific academic task addressed was story writing. Students were taught to set goals, monitor their performances, instruct themselves, and manage their effort expenditure, use of the strategy, and other behaviors. Performance improvements were made concrete through self-monitoring and graphing. After students were taught the strategies, instruction gradually shifted responsibility for their use to the students. Feedback and instructional support were individualized; students moved through the instruction and practice at their own pace.

Participants received 30-minute instructional sessions until they could achieve the criterion of independently writing a story with seven parts. These essential parts were identified with the mnemonic WWW, What = 2, How = 2: *Who* are the main characters? *Where* does the story take place? *When* does the story take place? *What* do the main characters want to do? *What* happens next? *How* does the story end? *How* do the main characters feel? In addition to this story writing mnemonic, SRSD also used a planning mnemonic to help students planning narrative stories: POW—"*Pick* my ideas," "*Organize* my notes," and, "*Write* and say more."

In the first part of the intervention—develop background knowledge—students were introduced to the planning and story-writing mnemonics by the teacher explaining them and then having students explain them and their importance. The instructor then engaged in modeling by reading stories aloud and having students pick out the seven parts.

In the second stage of instruction—discuss it—students continued to pick out story parts from stories the teacher read to them. Students then followed the same procedure in analyzing stories they had written to determine whether they had included all seven parts. They completed charts graphing the number of parts and number of words their stories included.

During the third "Model It" stage, the teacher explained and demonstrated use of the POW and the WWW, What = 2, How = 2 strategies by generating a story with student input that included all elements. As ideas were generated, the teacher wrote them on a planning sheet that included prompts for the seven parts of a good story. The teacher verbalized several statements to help idea generation; for example, problem definition (e.g., "What is my goal?"), planning (e.g., "What is my next step?"), self-evaluation (e.g., "Does that make sense?"), self-reinforcement (e.g., "I like that part!"), and coping (e.g., "I'm almost done!"). The teacher discussed with students the importance of verbalizing these statements, after which students created self-statements to use while writing.

The "Support It" stage was a collaborative writing experience as teacher and students wrote a story together using the mnemonics and graphic organizers. Students wrote the story and then verified that all seven elements were included. To develop their beliefs about the importance of strategy use, the teacher asked students how the strategies helped them write better stories.

During the final "Independent Performance" stage, students wrote stories independently after receiving a story prompt. When they finished, they graphed the number of story parts and number of words in the story.

Results of the intervention showed that students gained significantly in number of story parts addressed and number of words in stories. Maintenance tests given 3 and 6 weeks after the independent performance stage showed that gains were maintained.

This application of SRSD and others have shown that it benefits not only learners' knowledge and use of strategies for performance and motivation but also facilitates maintenance and generalization of self-regulated strategy use beyond the original learning setting. Although SRSD studies have not evaluated students' self-regulation development according to the levels of development postulated by Zimmerman (2000), the project descriptions show that the observation, emulation, and self-control levels are addressed and the results suggest that in many cases students may have reached the self-regulation level.

Self-Reflection and Self-Regulated Learning

Using Zimmerman's (2000) three-phase model of self-regulated learning, Zimmerman, Moylan, Hudesman, White, and Flugman (2011) developed a semester-long intervention designed to enhance the self-regulatory processes and achievement of at-risk undergraduate students in mathematics classes. These students—90% of whom came from diverse minority groups—attended an urban public technological college. More than half were born outside of the United States and spoke a language other than English at home. The graduation rate for an associate degree at the college was only 21% after 6 years. Despite these daunting challenges, many of these students reported overly confident self-efficacy, which can hinder their adaptive responses to academic feedback (Schunk & Pajares, 2009). The accuracy or calibration of students' self-efficacy beliefs with their actual performances is a particular problem among those who struggle academically (Pajares & Kranzler, 1995).

Using a randomized controlled research design, Zimmerman et al. (2011) sought to enhance these students' self-reflection responses to academic feedback through instructor modeling of error correction, guided self-reflection opportunities involving quiz correction forms, and an incentive system that rewarded completion of the self-reflection form with additional quiz points. These curricular components were designed to help students self-reflect more effectively on their errors during mathematics learning and improve their perceptions of traditional academic feedback (such as quiz grades). Instead of viewing mathematical solution errors as end points of learning, the students were taught to view them as opportunities for further learning. The self-reflection form prompted students to compare their self-efficacy and self-evaluative judgments with their outcome on each quiz item, explain their ineffective strategies, adopt more effective strategies, and indicate their confidence for solving a similar problem. It was hypothesized that students who were trained to use these self-regulatory processes on mathematics tests would outperform control students who received traditional instruction. Furthermore, self-regulated students were also expected to display less bias in their self-efficacy beliefs and self-evaluative judgments than control group students.

The results revealed that students in the self-reflection training group outperformed students in the control group on instructor-developed mathematics examinations. The self-regulation students also displayed less over-estimation bias in their task-specific self-efficacy beliefs before solving problems and in their self-evaluative judgments after solving problems. Self-reflection training also increased students' pass rate on a national gateway examination in mathematics by 25 percentage points in comparison to that of control group students.

During the study, the instructors reported that students in the self-regulation classes varied considerably in their individual use of the self-reflection forms. It was hypothesized that high self-reflectors would display higher achievement on the periodic and final exams than low self-reflectors. It was also expected that high self-reflectors would display less over-estimation bias in their self-efficacy and self-evaluation judgments than low self-reflectors. The results supported both hypotheses. Compared with low self-reflectors, high self-reflectors scored higher on periodic and final exams and displayed less over-estimation of self-efficacy and self-evaluation.

When interpreting the effects of self-regulation training on achievement, it should be noted that the intervention was a true experiment involving random assignment of at-risk students to classes in a technical college. Self-regulation instructors produced significantly higher mathematics achievement than conventional instructors, and these causal effects were statistically large or near large in size (Cohen, 1988).

FUTURE RESEARCH DIRECTIONS

Research on self-regulation has advanced tremendously in the past few years, and we expect this trend to continue. At the same time, there is much work to be done. In this section we suggest some profitable areas for future research, which will contribute to our understanding of the operation of self-regulation processes and have implications for educational practice.

Self-Regulation and Human Development

Greater exploration is needed of the link between self-regulation and human development. Developmental researchers have studied extensively how various cognitive functions (e.g., memory, metacognition) change with development (Meece, 2002). Much research shows that children can learn and use self-regulation strategies to improve their academic learning and motivation (Schunk & Zimmerman, 2008). A closer connection is needed between these two literatures.

For example, social constructivists contend that individuals form or construct much of what they learn and understand (Paris et al., 2001). Children are active learners who try to discover meaning in material to be learned and impose organization as needed. An important question is whether it is better to teach children self-regulation strategies or facilitate their constructing them on their own.

There are various ways that this question could be investigated. One means would be to compare the effectiveness of direct and constructivist teaching approaches for acquiring self-regulatory strategies. In a direct method, a teacher might explain and demonstrate the strategies, after which students could practice applying them and receive feedback. In a constructivist context, a teacher might form student groups and ask them to develop strategies for studying given material. To control for the effects of type of model, the direct approach also could include peers as teachers.

As informative as this research might be, it does not address the key role of home influences on self-regulation development. There are wide variations in the extent that parents and caregivers use self-regulatory skills and attempt to teach them to children (Meece, 2002). Longitudinal research is needed, which would show how much parents stress the importance of self-regulation and encourage and reward their children for attempts at self-regulation. Such long-term research could identify how parents' teaching and children's skills change as a function of children's developmental status.

Self-Regulation and the Curriculum

Research is needed on self-regulation in curriculum areas. When self-regulatory processes are linked with academic content, students learn how to apply them in learning contexts. It is worthwhile to teach students to set goals, organize their schedules, rehearse information to be remembered, and the like, but such instruction may not transfer beyond the context in which it is provided.

In the past few years, researchers increasingly have investigated the effects on learning and motivation of incorporating self-regulation instruction into academic curricula (Schunk & Zimmerman, 2008; Zimmerman & Schunk, 2011). For example, research has shown that students' motivation, learning, self-regulation, and achievement can be improved in such diverse content areas as reading, writing, science, and mathematics, and that students can be taught to adapt self-regulatory processes for use on academic content outside of the instructional context (Zimmerman & Schunk, 2011).

We recommend that this research direction be expanded. Additional studies are needed in academic learning settings where students are taught self-regulatory skills and how to modify them to fit different situations. These studies have the added benefit of showing students the value of self-regulation for their learning, motivation, and academic performance. Students who learn strategies but feel they are not especially useful are not likely to use them. From a motivational perspective, students who believe they can effectively use strategies to learn and perform better are apt to hold high self-efficacy for learning, which strengthens their motivation for continued learning (Schunk & Pajares, 2009).

An assignment that lends itself well to teaching self-regulation and cuts across different curriculum areas is writing a term paper. In middle schools it is common for teachers to team for instruction; for example, a team of two or three teachers might teach the same students language arts, social studies, mathematics, and science. Strategies for completing a term paper could be taught by the language arts teacher and would include such skills as setting goals and timelines, deciding on a topic, organizing ideas, collecting information, outlining, writing, and revising. The mathematics, science, and social studies teachers could further develop students' use of these skills by showing them how they can be adapted for use in their classes. This approach has practical significance for teaching and provides insight into methods for facilitating transfer of self-regulation strategies.

Self-Regulation Across Cultures

The earliest investigations into self-regulation were conducted in Western cultures. As interest in self-regulation has grown, researchers have explored the operation of self-regulatory processes in non-Western cultures. This trend is promising, and we recommend continued international growth of self-regulation research.

It is tempting to assume that self-regulatory processes operate much the same way in students regardless of culture, but that assumption is unwarranted. A culture reflects the values, traditions, and beliefs that affect the behaviors of a social group and the group's way of perceiving its social environment (McInerney, 2011). Given this perspective, it is erroneous to believe that individuals in different cultures hold the same meanings for the elements of self-regulated learning. For example, Chinese and Japanese cultures emphasize education, effort, and high achievement standards, and children in these cultures are expected to fulfill their parents' ambitions for them (McInerney, 2008). These students perform well in the type of structured situations common in their cultures, but may not display high levels of self-regulated behavior in less-structured situations. The types of self-regulated strategies discussed in this chapter (e.g., self-evaluation, goal setting, monitoring, environmental structuring) may not be strategies that Chinese and Japanese students are skilled in employing.

This is not to suggest that students in non-Western cultures do not display self-regulation. Effort expenditure, for example, is valued in Chinese and Japanese cultures (McInerney, 2008). Self-regulation covers not only cognitive strategies but emotional and motivational ones as well, of which the self-regulation of effort and persistence is critical. An expanded level of international research will identify the prevalent self-regulation strategies in different cultures and ways that students employ them productively to promote their learning and achievement.

Self-Regulation During Learning With Technology

The past several years have witnessed a rapid explosion of technology in instruction through electronic and distance education (Bernard et al., 2009; Brown, 2006). Technology has the potential to facilitate learning in ways that formerly were unknown. Compared with only a few years ago, today's students can experience simulations of events and environments, receive instruction from and communicate with others at long distances, and interact with large knowledge bases and expert tutoring systems.

Challenges for researchers are to determine which self-regulation strategies are helpful for learning from technology and how to teach students these strategies and raise their motivation for using them. Computer-based learning environments have many advantages over traditional instruction, but they typically lack the external controls found in traditional settings (e.g., teachers keeping students on task). It seems that many self-regulation strategies would be critical for learning in the absence of external regulation.

Research also is needed on how technology may help to improve students' self-regulated learning. Azevedo and his colleagues have shown how hypermedia learning environments can be structured to foster learners' self-regulated learning in such key areas as planning, knowledge activation, metacognitive monitoring, and self-reflection (Azevedo, 2005; Azevedo & Cromley, 2004; Azevedo et al., 2011). In their review of the distance education literature, Bernard et al. (2009) suggest that learning may be facilitated by increasing the quantity and quality of interactions among students. Self-regulation of the social environment is a key facet of self-regulated learning. Students who enroll in distance education courses may benefit from tutorials prior to beginning the courses that teach them strategies for interacting with their peers. The types of research suggested here should advance our understanding of the role of technology in self-regulation.

CONCLUSION

Self-regulation has become an integral topic in the study of human learning. Different theoretical perspectives on self-regulation have been advanced, and each has important implications for research and practice. As self-regulation research continues we expect that the knowledge base of self-regulation will be greatly expanded and we will learn much more about the operation of self-regulatory processes. More intervention studies will show how to best improve individuals' self-regulatory skills. In short, research on self-regulation will enhance our understanding of achievement processes and have important implications for teaching and learning.

REFERENCES

Alexander, J. E., Carr, M., & Schwanenflugel, P. J. (1995). Development of metacognition in gifted children: Directions for future research. *Developmental Review, 15*, 1–37.

Anderson, J. R. (1996). ACT: A simple theory of complex cognition. *American Psychologist, 51*, 355–365.

Anderson, J. R. (2000). *Learning and memory: An integrated approach* (2nd ed.). New York, NY: Wiley.

Azevedo, R. (2005). Using hypermedia as a metacognitive tool for enhancing student learning? The role of self-regulated learning. *Educational Psychologist, 40*, 199–209.

Azevedo, R., & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students' learning with hypermedia? *Journal of Educational Psychology, 96*, 523–535.

Azevedo, R., Johnson, A., Chauncey, A., & Graesser, A. (2011). Use of hypermedia to assess and convey self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 102–121). New York, NY: Routledge.

Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. In P. D. Pearson (Ed.), *Handbook of reading research* (pp. 353–394). New York, NY: Longman.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1–26.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41*, 586–598.

Belfiore, P. J., & Hornyak, R. S. (1998). Operant theory and application to self-monitoring in adolescents. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 184–202). New York, NY: Guilford Press.

Berk, L. E. (1986). Relationship of elementary school children's private speech to behavioral accompaniment to task, attention, and task performance. *Developmental Psychology, 22*, 671–680.

Bernard, R. M., Abrami, P. C., Borokhovski, E., Wade, C. A., Tamim, R. M., Surkes, M. A., & Bethel, E. C. (2009). A meta-analysis of three types of interactiontreatments in distance education. *Review of Educational Research, 79*, 1243–1289.

Boekaerts, M., Pintrich, P. R., & Zeidner, M. (Eds.). (2000). *Handbook of self-regulation*. San Diego, CA: Academic Press.

Borkowski, J. G., Johnston, M. B., & Reid, M. K. (1987). Metacognition, motivation, and controlled performance. In S. J. Ceci (Ed.), *Handbook of cognitive, social, and neuropsychological aspects of learning disabilities* (Vol. 2, pp. 147–173). Hillsdale, NJ: Erlbaum.

Brigham, T. A. (1982). Self-management: A radical behavioral perspective. In P. Karoly & F. H. Kanfer (Eds.), *Self-management and behavior change: From theory to practice* (pp. 32–59). New York, NY: Pergamon.

Brown, I. Jr., & Inouye, D. K. (1978). Learned helplessness through modeling: The role of perceived similarity in competence. *Journal of Personality and Social Psychology, 36*, 900–908.

Brown, J. S. (2006, September/October). New learning environments for the 21stcentury: Exploring the edge. *Change, 38*, 18–24.

Brown, J. S., & Burton, R. R. (1978). Diagnostic models for procedural bugs in basic mathematical skills. *Cognitive Science, 2*, 155–192.

Buehl, M. M., & Alexander, P. A. (2009). Beliefs about learning in academic domains. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 479–501). New York, NY: Routledge.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior.* New York, NY: Cambridge University Press.

Cleary, T. J., Zimmerman, B. J., & Keating, T. (2006). Training physical education students to self-regulate during basketball free throw practice. *Research Quarterly for Exercise and Sport, 77*, 251–262.

Cohen, J. (1988). *Statistical power analyses for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

DiBenedetto, M. K., & Zimmerman, B. J. (2010). Differences in self-regulatory processes among students studying science: A microanalytic investigation. *International Journal of Educational and Psychological Assessment, 5*(1), 2–24.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review, 20*, 391–409.

Dowrick, P. W. (1999). A review of self modeling and related interventions. *Applied & Preventive Psychology, 8*, 23–39.

Dweck, C. S. (2006). *Mindset: The new psychology of success.* New York, NY: Random House.

Dweck, C. S., & Master, A. (2008). Self-theories motivate self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning:Theory, research, and applications* (pp. 31–51). New York, NY: Taylor & Francis.

Fabricius, W. V., & Hagen, J. W. (1984). Use of causal attributions about recall performance to assess metamemory and predict strategic memory behavior in young children. *Developmental Psychology, 20*, 975–987.

Flavell, J. H. (1999). Cognitive development: Children's knowledge about the mind. *Annual Review of Psychology, 50*, 21–45.

Fuchs, L. S., Fuchs, D., Prentice, K., Burch, M., Hamlett, C. L., Owen, R., . . . Jancek, D. (2003). Explicitly teaching for transfer: Effects on third-grade students' mathematical problem solving. *Journal of Educational Psychology, 95*, 293–305.

Fuson, K. C. (1979). The development of self-regulating aspects of speech: A review. In G. Zivin (Ed.), *The development of self-regulation through private speech* (pp. 135–217). New York, NY: Wiley.

Gitomer, D. H., & Glaser, R. (1987). If you don't know it work on it: Knowledge, self-regulation and instruction. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, learning, and instruction* (Vol. 3, pp. 301–325). Hillsdale, NJ: Erlbaum.

Graham, S., & Williams, C. (2009). An attributional approach to motivation in school. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 11–33). New York, NY: Routledge.

Greene, J. A., & Azevedo, R. (2007). A theoretical review of Winne and Hadwin's modelof self-regulated learning: New perspectives and directions. *Review of Educational Research, 77*, 334–372.

Greene, J. A., & Azevedo, R. (2009). A macro-level analysis of SRL processes and theirrelations to the acquisition of a sophisticated mental model of a complexsystem. *Contemporary Educational Psychology, 34*, 18–29.

Hadwin, A. F., Järvelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and sociallyshared regulation of learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 65–84). New York, NY: Routledge.

Harris, K. R., Graham, S., MacArthur, C. A., Reid, R., & Mason, L. H. (2011). Self-regulated learning processes and children's writing. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 187–202). New York, NY: Routledge.

Harris, K. R., Graham, S., & Mason, L. H. (2006). Improving the writing, knowledge, and motivation of struggling young writers: Effects of Self-Regulated StrategyDevelopment with and without peer support. *American Educational Research Journal, 43*, 295–340.

Harris, K. R., Graham, S., Mason, L. H., & Friedlander, B. (2008). *Powerful writingstrategies for all students.* Baltimore, MD: Brookes.

Kail, R. V., & Ferrer, E. (2007). Processing speed in childhood and adolescence: Longitudinal models for examining developmental change. *Child Development, 78*, 1760–1770.

Kanfer, F. H., & Gaelick, K. (1986). Self-management methods. In F. H. Kanfer & A. P. Goldstein (Eds.), *Helping people change: A textbook of methods* (3rd ed., pp. 283–345). New York, NY: Pergamon Press.

Karoly, P., & Kanfer, F. H. (Eds.) (1982). *Self-management and behavior change: From theory to practice.* New York, NY: Pergamon Press.

Kochanska, G., Tjebkes, T. L., & Forman, D. R. (1998). Children's emerging regulation of conduct: Restraint, compliance, and internalization from infancy to the second year. *Child Development, 69*, 1378–1389.

Kopp, C. B. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology, 18*, 199–214.

Kosiewicz, M. M., Hallahan, D. P., Lloyd, J., & Graves, A. W. (1982). Effects of self-instruction and self-correction procedures on handwriting performance. *Learning Disability Quarterly, 5*, 71–78.

Lan, W. Y. (1998). Teaching self-monitoring skills in statistics. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 86–105). New York, NY: Guilford Press.

Licht, B. G., & Kistner, J. A. (1986). Motivational problems of learning-disabled children: Individual differences and their implications for treatment. In J. K. Torgesen & B. W. L. Wong (Eds.), *Psychological and educational perspectives on learning disabilities* (pp. 225–255). Orlando, FL: Academic Press.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist, 57*, 705–717.

Lodico, M. G., Ghatala, E. S., Levin, J. R., Pressley, M., & Bell, J. A. (1983). The effects of strategy-monitoring training on children's selection of effective memory strategies. *Journal of Experimental Child Psychology, 35*, 263–277.

Lord, R. G., Diefendorff, J. M., Schmidt, A. M., & Hall, R. J. (2010). Self-regulationat work. *Annual Review of Psychology, 61*, 543–568.

Luria, A. R. (1961). *The role of speech in the regulation of normal and abnormal behavior* (J. Tizard, Trans.). New York, NY: Liveright.

Mace, F. C., Belfiore, P. J., & Hutchinson, J. M. (2001). Operant theory and research onself-regulation. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 39–65). Mahwah, NJ: Erlbaum.

Mace, F. C., Belfiore, P. J., & Shea, M. C. (1989). Operant theory and research on self-regulation. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 27–50). New York, NY: Springer-Verlag.

Mace, F. C., & West, B. J. (1986). Unresolved theoretical issues in self-management: Implications for research and practice. *Professional School Psychology, 1*, 149–163.

Mason, L. H. (2004). Explicit self-regulated strategy development versus reciprocal questioning: Effects on expository reading comprehension among struggling readers. *Journal of Educational Psychology, 96*, 283–296.

Matlin, M. W. (2009). *Cognition* (7th ed.). Hoboken, NJ: Wiley.

McInerney, D. M. (2008). The motivational roles of cultural differences and culturalidentity in self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 369–400). New York, NY: Taylor & Francis.

McInerney, D. (2011). Culture and self-regulation in educational contexts: Assessingthe relationship of cultural group to self-regulation. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 442–464). New York, NY: Routledge.

Meece, J. L. (2002). *Child and adolescent development for educators.* Boston, MA: McGraw-Hill.

Miller, G. A., Galanter, E., & Pribram, K. H. (1960). *Plans and the structure of behavior*. New York, NY: Holt, Rinehart & Winston.

Nesbit, J. C., & Adescope, O. O. (2006). Learning with concept and knowledge maps: Ameta-analysis. *Review of Educational Research, 76*, 413–448.

Nicholls, J. G. (1978). The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Development, 49*, 800–814.

O'Leary, S. G., & Dubey, D. R. (1979). Applications of self-control procedures by children: A review. *Journal of Applied Behavior Analysis, 12*, 449–466.

Pajares, F., & Kranzler, J. (1995). Self-efficacy beliefs and general mental ability inmathematical problem-solving. *Contemporary Educational Psychology, 29*, 426–433.

Paris, S. G., & Byrnes, J. P. (1989). The constructivist approach to self-regulation and learning in the classroom. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self- regulated learning and academic achievement: Theory, research, and practice* (pp. 169–200). New York, NY: Springer-Verlag.

Paris, S. G., Byrnes, J. P., & Paris, A. H. (2001). Constructing theories, identities, and actions of self-regulated learners. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 253–287). Mahwah, NJ: Erlbaum.

Paris, S. G., Newman, R. S., & McVey, K. A. (1982). Learning the functional significance of mnemonic actions: A microgenetic study of strategy acquisition. *Journal of Experimental Child Psychology, 34*, 490–509.

Paris, S. G., & Oka, E. R. (1986). Children's reading strategies, metacognition, and motivation. *Developmental Review, 6*, 25–56.

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36*, 89–101.

Pavlov, I. P. (1927). *Conditioned reflexes* (G. V. Anrep, Trans.). New York, NY: International.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). San Diego, CA: Academic Press.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*, 385–407.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*, 33–40.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1993). Reliability andpredictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement, 53*, 801–813.

Pintrich, P. R., & Zusho, A. (2002). The development of academic self-regulation: The role of cognitive and motivational factors. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation* (pp. 249–284). San Diego, CA: Academic Press.

Pressley, M., Woloshyn, V., Lysynchuk, L. M., Martin, V., Wood, E., & Willoughby, T. (1990). A primer of research on cognitive strategy instruction: The important issues and how to address them. *Educational Psychology Review, 2*, 1–58.

Reid, R., & Lienemann, T. O. (2006). Self-Regulated Strategy Development for written expression with students with attention deficit/hyperactivity disorder. *Exceptional Children, 73*, 53–68.

Reid, R., Trout, A. L., & Schartz, M. (2005). Self-regulation interventions for children with attention deficit/hyperactivity disorder. *Exceptional Children, 71*, 361–377.

Sagotsky, G., Patterson, C. J., & Lepper, M. R. (1978). Training children's self-control: A field experiment in self-monitoring and goal-setting in the classroom. *Journal of Experimental Child Psychology, 25*, 242–253.

Samuelson, L. K., & Smith, L. B. (2000). Grounding development in cognitiveprocesses. *Child Development, 71*, 98–106.

Schraw, G. (2007). The use of computer-based environments for understanding and improving self-regulation. *Metacognition and Learning, 2* (2–3), 169–176.

Schunk, D. H. (1981). Modeling and attributional effects on children's achievement: A self-efficacy analysis. *Journal of Educational Psychology, 73*, 93–105.

Schunk, D. H. (1982). Verbal self-regulation as a facilitator of children's achievement and self-efficacy. *Human Learning, 1*, 265–277.

Schunk, D. H. (1983a). Goal difficulty and attainment information: Effects on children's achievement behaviors. *Human Learning, 2*, 107–117.

Schunk, D. H. (1983b). Progress self-monitoring: Effects on children's self-efficacy and achievement. *Journal of Experimental Education, 51*, 89–93.

Schunk, D. H. (1996). Goal and self-evaluative influences during children's cognitive skill learning. *American Educational Research Journal, 33*, 359–382.

Schunk, D. H., & Cox, P. D. (1986). Strategy training and attributional feedback with learning disabled students. *Journal of Educational Psychology, 78*, 201–209.

Schunk, D. H., & Ertmer, P. A. (1999). Self-regulatory processes during computer skill acquisition: Goal and self-evaluative influences. *Journal of Educational Psychology, 91*, 251–260.

Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology, 77*, 313–322.

Schunk, D. H., & Hanson, A. R. (1989). Self-modeling and children's cognitive skill learning. *Journal of Educational Psychology, 81*, 155–163.

Schunk, D. H., Hanson, A. R., & Cox, P. D. (1987). Peer-model attributes and children's achievement behaviors. *Journal of Educational Psychology, 79*, 54–61.

Schunk, D. H., & Pajares, F. (2009). Self-efficacy theory. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 35–53). New York, NY: Routledge.

Schunk, D. H., & Rice, J. M. (1987). Enhancing comprehension skill and self-efficacy with strategy value information. *Journal of Reading Behavior, 19*, 285–302.

Schunk, D. H., & Swartz, C. W. (1993). Goals and progress feedback: Effects on self-efficacy and writing instruction. *Contemporary Educational Psychology, 18*, 337–354.

Schunk, D. H., & Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educational Psychologist, 32*, 195–208.

Schunk, D. H., & Zimmerman, B. J. (Eds.) (2008). *Motivation and self-regulatedlearning: Theory, research, and applications.* New York, NY: Taylor & Francis.

Siegler, R. S., & Svetina, M. (2006). What leads children to adopt new strategies? Amicrogenetic/cross-sectional study of class inclusion. *Child Development, 77*, 997–1015.

Skinner, B. F. (1953). *Science and human behavior*. New York, NY: Macmillan.

Snowman, J. (1986). Learning tactics and strategies. In G. D. Phye & T. Andre (Eds.), *Cognitive classroom learning: Understanding, thinking, and problem solving* (pp. 243–275). Orlando, FL: Academic Press.

Swanson, H. L. (2008). Working memory and intelligence in children: What develops? *Journal of Educational Psychology, 100*, 581–602.

Tudge, J., & Scrimsher, S. (2003). Lev S. Vygotsky on education: A cultural-historical, interpersonal, and individual approach to development. In B. J. Zimmerman & D. H. Schunk (Ed.), *Educational psychology: A century of contributions* (pp. 207–228). Mahwah, NJ: Erlbaum.

Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 315–327). New York, NY: Macmillan.

Winne, P. H. (2001). Self-regulated learning viewed from models of information processing. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 153–189). Mahwah, NJ: Erlbaum.

Winne, P. H. (2011). A cognitive and metacognitive analysis of self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 15–32). New York, NY: Routledge.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277–304). Mahwah, NJ: Erlbaum.

Winne, P. H., & Hadwin, A. F. (2008). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 297–314). New York, NY: Taylor & Francis.

Zimmerman, B. J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 1–19). New York, NY: Guilford Press.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). San Diego, CA: Academic Press.

Zimmerman, B. J. (2001). Theories of self-regulated learning and academic achievement: An overview and analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 1–38). Mahwah, NJ: Erlbaum.

Zimmerman, B. J. (2008). Goal setting: A key proactive source of academic self-regulation. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 367–395). New York, NY: Taylor & Francis.

Zimmerman, B. J. (2011). Motivational sources and outcomes of self-regulated learningand performance. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 49–64). New York, NY: Routledge.

Zimmerman, B. J., Bonner, S., & Kovach, R. (1996). *Developing self-regulated learners: Beyond achievement to self-efficacy*. Washington, DC: American Psychological Association.

Zimmerman, B. J., & Kitsantas, A. (1996). Self-regulated learning of a motoric skill: The role of goal setting and self-monitoring. *Journal of Applied Sport Psychology*, *8*, 60–75.

Zimmerman, B. J., & Kitsantas, A. (1997). Developmental phases in self-regulation: Shifting from process goals to outcome goals. *Journal of Educational Psychology, 89*, 29–36.

Zimmerman, B. J., & Kitsantas, A. (2002). Acquiring writing revision and self-regulatory skill through observation and emulation. *Journal of Educational Psychology, 94*, 660–668.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing students' use of self-regulated learning strategies. *American Educational Research Journal*, *23*, 614–628.

Zimmerman, B. J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology, 82*, 51–59.

Zimmerman, B. J., Moylan, A., Hudesman, J., White, N., & Flugman, B. (2011). Enhancing self-reflection and mathematics achievement of at-risk urban technical college students. *Psychological Test and Assessment Modeling, 53*, 108–127.

Zimmerman, B. J., & Ringle, J. (1981). Effects of model persistence and statements of confidence on children's self-efficacy and problem solving. *Journal of Educational Psychology, 73*, 485–493.

Zimmerman, B. J., & Schunk, D. H. (2004). Self-regulating intellectual processes andoutcomes: A social cognitive perspective. In D. Y. Dai & R. J. Sternberg (Eds.), *Motivation, emotion, and cognition: Integrative perspectives on intellectual functioning and development* (pp. 323–350). Mahwah, NJ: Erlbaum.

Zimmerman, B. J., & Schunk, D. H. (Eds.) (2011). *Handbook of self-regulation of learning and performance.* New York, NY: Routledge.

CHAPTER 4

Metacognition, Learning, and Instruction

CHRISTINE B. McCORMICK, CAREY DIMMITT, AND FLORENCE R. SULLIVAN

INTRODUCTION

What are the characteristics of academically successful students? Successful college students have built an extensive knowledge base, but what is perhaps even more significant, they possess a vast repertoire of strategies for accessing their knowledge and for acquiring new information to add to their knowledge base. As they study, they are able to monitor when they do not understand and know when and how to use effective strategies to improve their understanding. When they are assigned a large project or paper, they exhibit the necessary planning and organization skills to complete the project in a timely fashion. These behaviors are indicators of high levels of metacognitive knowledge and skill. Given that sophisticated metacognition is a quality found in academically successful students, one way to support the development of academic skills in students is to foster the development of metacognition. This chapter focuses on metacognitive knowledge and skills as they develop in older, more experienced and skilled students (middle school, high school, college students) and instructional methods that support the development of metacognition. For a review of the development of metacognition in younger students and novice learners, consult Dimmitt and McCormick (in press).

We begin the chapter by examining various definitions of metacognition and how the prevailing perspectives on metacognition fit together with the related constructs of executive function and self-regulation. Next we describe some of the methods and approaches used by researchers to measure metacognition in their studies. Then we summarize research on metacognition in learning contexts, beginning with a consideration of general versus domain-specific metacognitive knowledge and skills. We then review research on metacognition in specific academic disciplines and on effective instructional methods to increase metacognitive knowledge and skills. We also address the role of teachers in supporting and modeling metacognition in their classrooms and methods for scaffolding metacognition in computer-based learning environments. Finally, we conclude with a discussion of likely future directions in theories of and research on metacognition.

DEFINITION OF METACOGNITION

Metacognition emerged as a specific focus of research in the early 1970s, although the knowledge and skills underlying this construct have been observed by educators and psychologists for decades and originate in the theoretical insights proffered by James, Piaget, and Vygotsky (Fox & Riconscente, 2008). John Flavell (1976) proposed an early definition of metacognition as "knowledge concerning one's own cognitive processes and products or anything related to them" (p. 232), which he later condensed to what he termed the core meaning of "cognition about cognition" (Flavell, 1985, p. 104) or to use the common vernacular, "thinking about thinking." This definition seems simple and intuitive but an examination of the research literature on metacognition makes it evident that some researchers and theorists operate with different working definitions of metacognition. In their review of the research literature on metacognition and self-regulated learning, Dinsmore, Alexander, and Loughlin (2008) reported that researchers provided an explicit definition of metacognition in only 32% of the 255 studies reviewed.

How researchers defined metacognition and the particular components they emphasized in their definition often depended on the theoretical tradition of the researcher (cognitive developmental, cognitive science, educational psychology, social learning, cognitive behavioral, sociocultural) and the types of learning tasks studied. The context within which researchers operate influences how they frame the construct of metacognition and how they understand the relationship of metacognition to other related theoretical concepts. In general, however, metacognitive researchers tend to identify two facets of metacognition, *knowledge* about cognition and *control* over cognition (Veenman, Van Hout-Wolters, & Afflerbach, 2006), but how metacognitive knowledge and control is conceptualized varies widely. For example, coming from a cognitive developmental approach, in an influential article, Jacobs and Paris (1987) delineated declarative, procedural, and conditional aspects of metacognitive knowledge. *Declarative metacognitive knowledge* refers to knowledge about cognitive processes and about factors that affect cognitive processing. Learners vary in the quality of their declarative knowledge depending on a variety of factors including age and ability. *Procedural metacognitive knowledge* refers to knowledge of how to execute procedures such as learning strategies. The procedural knowledge of skilled learners is more automatic, accurate, and effective than that of unskilled learners. *Conditional metacognitive knowledge* refers to knowledge about when and why to use procedures or strategies. The conditional knowledge of successful learners allows them to be facile and flexible in their strategy use. Jacobs and Paris also articulated the processes comprising metacognitive control. *Planning* involves the selection of a strategy or plan of action to achieve a goal. *Evaluation* refers to monitoring the progress made toward achieving the goal. *Regulation* includes the revision or modification of the strategies to achieve the goal.

Alternatively, cognitive scientists studying metacognition in controlled learning situations, such as paired-associate learning, tended to be guided by the Nelson and Narens (e.g., 1990, 1994) model of metacognition, which makes a distinction between "object-level" where cognition occurs and "meta-level," which oversees "object-level." In this model, metacognitive knowledge is supported by the metacognitive processes of monitoring and control (Dunlosky & Metcalfe, 2009; Schwartz & Bacon, 2008). Monitoring processes, such as assessing progress and judging the likelihood of success, convey information about the object-level to the meta-level. Instructions from the meta-level are conveyed to object-level through control processes, such as the regulation of cognitive activity and the actions taken to support task completion, including adjustment of the approaches taken or strategies used and the allocation of resources, such as study time. Although this approach emerges from a vastly different research tradition, similar to other approaches described above, the emphasis is on a distinction between metacognitive knowledge and processes of monitoring and control.

Metacognition and Self-Regulation

The theoretical origins of the concept of metacognition as articulated by Flavell, Paris can be traced to cognitive developmental psychology, whereas the study of self-regulation emerged from social learning and cognitive behavioral theory and research (Dinsmore, Alexander, & Loughlin, 2008). The underlying theoretical approach is reflected in a basic distinction between the two constructs. Metacognition is concerned with cognition, the knowledge and control of cognitive processes, and thought and learning processes. Self-regulation, the broader concept, also encompasses behavioral and emotional regulation, most notably motivation (see Schunk & Zimmerman, this volume).

As Zimmerman (1995) argued, "Self-regulation involves more than metacognitive knowledge and skill, it involves an underlying sense of self-efficacy and personal agency and the motivational and behavioral processes to put these self -beliefs into effect" (p. 217). A learner could have well-developed metacognitive knowledge, but be unable to self-regulate in a specific context. Self-regulated learning refers to the "capability to mobilize, direct, and sustain one's instructional efforts" (p. 217). So self-regulated learning is "more than metacognitive knowledge and skill, it involves a sense of personal agency to regulate other sources of personal influence (e.g., emotional processes and behavioral and social—environmental sources of influence" (p. 218).

Despite this apparent clarity in distinguishing between metacognition and self-regulation, in their review of the research, Dinsmore et al. (2008) reported considerable overlap in the terms researchers use to define the two constructs and in the measures they use to assess metacognition and self-regulation.

A new model of self-regulation proposed by Efklides (2011), the metacognitive and affective self-regulated learning (MASRL) model, highlighted the close linkage of metacognition and affect with cognition. Efklides argued that models of self-regulation vary in terms of whether the self is the basic organizing principle, top-down processing, or whether the task is the organizing principle, bottom-up processing, with self as the background. In contrast, the MASRL model posits two levels of functioning, the Person level and the Person X Task level. The Person level encompasses cognitive ability, including metacognitive knowledge (MK) and metacognitive skills (MS). MK is the representation of cognition; MS are the means to control cognition. Metacognitive skills include orientation strategies, planning strategies, strategies for regulation of cognitive processing, strategies for monitoring execution of planned action, and strategies for evaluating the outcome. The Task X Person level is where learning events occur, including metacognitive experiences (ME), such as a feeling of difficulty and online affective states. ME experiences during task processing include active MK and metacognitive judgments and feelings. The MASRL model reflects a growing consensus that metacognition is most easily understood as an essential component of self-regulated learning.

Metacognition and Executive Function

Executive function, which includes aspects of both metacognition and self-regulation, is another theoretical perspective that has become increasingly prominent in education and psychology. The concept of executive function emerged from the work of neuropsychologists in clinical practice as they identified deficits in cognitive functioning observed in their clients with brain injuries, ADHD, and autism spectrum disorders (Meltzer, 2007). As a result, executive function is studied much more in clinical populations, with less attention given to understanding executive function in the general population. Thus, the research focus has been on identifying and measuring deficits in executive functioning, using tools such as neuropsychological batteries and brain-imagining techniques. Researchers and clinicians have identified deficits in executive function skills, but have yet to reach agreement on a precise definition of executive function or consensus on a list of specific executive skills (Fischer & Daley, 2007; Meltzer & Krishnan, 2007).

Drawing from various models of executive function and applying them to educational contexts, Dawson and Guare (2010) described executive skills as organized around thinking skills and skills to guide behavior oriented toward achieving a goal. Executive thinking skills include planning, organization, time management, working memory, and metacognition. Executive skills to guide behavior include response inhibition, self-regulation of affect (emotional control), sustained attention, task initiation, flexibility, and goal-directed persistence. Thus, metacognitive constructs can fit within the executive function theoretical framework and self-regulated learning models, which typically emphasize motivational constructs, feature the executive function processes that are particularly relevant to applied learning settings. Some researchers would argue that executive function is the superordinate theoretical construct; others suggest that evidence exists supporting an overlapping relationship rather than a hierarchical one (Garner, 2009).

In summary, despite significant progress in articulating the relationship between metacognition and other related constructs since McCormick (2003), "fuzzy" boundaries between the related concepts of metacognition, self-regulation, and executive function still exist. Although researchers tend to draw on the theoretical distinctions present in the research tradition most relevant to their respective fields, increasing awareness of the multiple theoretical perspectives and greater communication between disciplines portends substantial movement toward the long sought comprehensive and unified theory of metacognition (Schraw, 2000). Much of the research reviewed in this chapter evolved from the developmental and educational psychology perspectives and from research focused on self-regulated learning in classroom contexts, although some of the research produced by cognitive psychologists studying metacognition in controlled learning situations is also included. Throughout this chapter, whenever possible, we highlight the theoretical distinctions made in the research reviewed.

ASSESSMENT OF METACOGNITION

Not surprisingly, given the various perspectives on the definition of metacognition, and the intermingling of metacognition with related concepts such as self-regulation and executive function, researchers have taken a number of different approaches to measuring the construct. Some measures of metacognition include indices of actual performance, such as calibration techniques where learners' predictions are compared to their actual performance. Other measures, including a variety of metacognitive questionnaires, ask learners to self-report their usual metacognitive activities, typically out of context from any actual cognitive task. Still other researchers create their own informal measures to use in a specific context. Assessments of metacognition also differ in terms of whether they are measures presented offline, presented *before* or *after* task performance, or online, presented *during* task performance. Each method has its proponents and its characteristic strengths and weaknesses.

Verbal Report Methods

Verbal report methods, such as interviews and think-aloud protocols, are used to externalize metacognitive knowledge and process. Interviews are retrospective (offline) verbalizations of metacognitive knowledge and control; think-alouds are concurrent (online) verbalizations of thoughts and cognitive processes while performing a task. Some researchers argue that online measures are more predictive of actual learning performance than offline measures (Veenman et al., 2006; Wirth & Leutner, 2008).

One criticism of metacognitive interviews is that they are less accurate sources of information because they take place at a time distant from the actual processing. Think-alouds, on the other hand, are concurrent with learning activity but the process of describing the cognition as it occurs may, in fact, disrupt or alter the cognitive activity. One way to make interviews more adjacent to actual processing situations is to include hypothetical situations designed to elicit responses in the interview protocol. Another technique for increasing the accuracy of metacognitive interviews is to stimulate recall by asking learners to comment as they watch a videotape of a previous cognitive activity. In this interview combined with stimulated recall method, the cognitive activity is real, not hypothetical, and although the interview is distant, vivid memory prompts are available in the videotape, which may increase the accuracy of the recollections.

Verbal report methods, such as think-alouds and interviews, can be cumbersome in terms of administration and scoring, typically requiring detailed verbal protocol analysis. Researchers using such techniques develop rubrics to help them analyze their data. For example, Azevedo and colleagues (Azevedo & Cromley, 2004; Azevedo, Cromley & Seibert, 2004; Azevedo, Guthrie, & Seibert, 2004) developed a rubric to analyze the data of students who are asked to think-aloud while studying complex systems in hypermedia environments. This rubric consists of five categories of activity including planning, monitoring, strategy usage, task difficulty and interest. Each of these categories contains multiple activities that students may engage in while studying in a hypermedia system. The planning, monitoring and task difficulty categories are most directly related to metacognition and include actions such as judgment of learning, feeling of knowing, self-questioning, monitoring progress toward goals, and time-and-effort planning.

Metacognitive Questionnaires

Other researchers have focused on developing questionnaires to assess metacognitive knowledge and behaviors. Questionnaires have the advantages of being easier to use with large groups of students, are less time-consuming to score, and can be readily quantified for analysis. Concerns, however, have been raised about the potential for response bias, specifically the social desirability of responses, and about whether or not the scores on questionnaires are closely related to learning outcomes (Richardson, 2004). As Pintrich (2004) noted, metacognitive questionnaires can assess aptitudes or propensities but do not measure actual metacognitive performance. Nonetheless metacognitive questionnaires are featured in many metacognitive studies.

One of the most widely used questionnaires, the *Motivated Strategies for Learning Questionnaire* (MSLQ), was developed by Paul Pintrich and Wilbert J. McKeachie, evolving from a social cognitive theoretical perspective and through a multiyear program of research, to assess student motivation and use of learning strategies situated in classroom settings (Pintrich, 2004; Pintrich, Smith, Garcia, & McKeachie, 1993). An initial purpose of the 81-item self-report instrument was to assess the effectiveness of courses on students, with an underlying assumption that students' responses would vary as a result of course experiences. The MSLQ, uses a 7-point Likert-type scale, 1 (not at all true of me) to 7 (very true of me), and consists of motivational scales (31 items, six subscales) and learning strategies scales (50 items, 9 subscales). The learning strategies scales include subscales assessing cognitive, metacognitive, and resource management strategies. The cognitive strategies subscale includes an assessment of rehearsal, elaboration, and organization strategies, as well as critical thinking. The metacognitive strategies subscale assesses planning, monitoring, and regulating. The resource management subscale refers to managing time and the study environment, the regulation of effort, peer learning, and help-seeking behavior.

In their retrospective on the development of the MSLQ and its subsequent impact on educational research, Duncan and McKeachie (2005) characterized the MSLQ as an efficient practical, ecological valid, well-established measure that has been used widely, in hundreds of studies, particularly in evaluations of university courses offered by offices of student affairs. Versions of the MSLQ have been created in other languages (e.g., Lee, Zhang, & Yin, 2010) and a shorter version (44 item) was developed for younger (junior high school) students (Pintrich & DeGroot, 1990).

Building from the primary theoretical distinction between knowledge and control of cognitive processes in the definition of metacognition described earlier, Schraw and Dennison developed another prominent metacognitive questionnaire, the *Metacognitive Awareness Inventory* (MAI), to measure the knowledge of cognition and the regulation of cognition in adolescents and adults (Schraw & Dennison, 1994). The MAI is comprised of 52 Likert-scale items (5-point), divided into two scales, knowledge of cognition and regulation of cognition. Factor analysis indicated that the two factors (knowledge and regulation of metacognition) were reliable and intercorrelated. Knowledge refers to the awareness of strengths and weaknesses, knowledge of strategies, and conditional knowledge (the "why" and "when" of strategy use). To assess knowledge and regulation of metacognition in younger students (grades 3 to 9), Sperling, Howard, Miller, and Murphy (2002) created the Jr. MAI, a 12-item scale with a three-choice response (never, sometimes, or always).

Researchers interested in metacognitive processing during test taking developed a metacognitive scale, the State Post Thinking Questionnaire (O'Neil & Abedi, 1996), which measures *state metacognition* experienced by students while completing cognitive assessments. The instrument has four subscales measuring different aspects of metacognition during test taking, *awareness, cognitive strategy, planning,* and *self-checking*. Research with community college students and 12th-grade students has indicated that higher levels of state medication, as measured by this instrument, led to better test performance.

Other questionnaires have been developed to assess metacognitive in specific content domains such as reading and science. For example, Mokhtari and Reichard (2002) designed the *Metacognitive Awareness of Reading Strategies Inventory* (MARSI) to assess adolescent and adult readers' metacognitive awareness and perceived use of academic reading strategies. The scale consists of global reading strategies (13 items)—strategies for global analysis of text, problem-solving strategies (8 items)—strategies for solving problems when text becomes difficult to read, and support reading strategies (9 items)—use of practical support strategies such as taking notes, accessing reference materials. Another measure focusing on reading processes is the *Metacomprehension Scale* (MCS), which consists of 22 Likert-scale (5-point) statements about seven components of reading comprehension abilities and strategies (Moore, Zabrucky, & Commander, 1997). The seven subscales are regulation (methods of resolving comprehension failures), strategy (techniques to improve comprehension), tasks (knowledge of basic comprehension processes), capacity (perception of comprehension abilities), anxiety (stress related to comprehension performance), achievement (importance of good comprehension skills), and locus (control of reading skills). Thomas, Anderson, and Nashon (2008) developed a bilingual instrument (English and traditional Chinese) to assess science students' metacognition, self-efficacy, and learning processes. Exploratory factor analysis and Rasch analyses resulted in a 30-item, 5-subscale instrument called the SEMLI-S. One of the subscales (9 items), monitoring, evaluation, and planning (MEP) clearly assesses metacognitive processes in science learning.

Learning strategies inventories are a related category of questionnaires found in the research literature on academic skills, most prominently, the LASSI—Learning and Study Strategies Inventory (Weinstein, Zimmerman, & Palmer, 1988), but also the Study Process Questionnaire—SPQ (Biggs, 1987). Study strategy inventories, often used in undergraduate study skills courses to diagnose student strengths and weaknesses, tend not to focus on metacognitive processes explicitly although some recently developed study strategy inventories, such as the ILS, the Inventory of Learning Styles (Vermunt & Vermetten, 2004) and ALSI, the Approaches to Learning and Studying Inventory, include subscales measuring metacognitive processes (see Entwistle & McCune, 2004, for a review).

Although not an extensive body of research, some researchers have explored the interrelationships between various measures of metacognition. Sperling, Howard, Staley, and DuBois (2004) examined the interrelationships between the MAI, the MSLQ and the Learning Strategies Survey (LSS) (a study strategies inventory developed by Kardash & Amlund, 1991). They replicated the finding that knowledge of metacognition and regulation of metacognition are strongly related (e.g., Schraw & Dennison, 1994) and found a significant correlation between scores on the MAI and scores on the MLSQ. Vrugt and Oort (2008) studied metacognition, achievement goals, and study strategies of first-year college students exploring pathways that best predicted academic achievement (course performance as measured by a multiple choice and essay exam). They used the MSLQ, the MAI, and a shortened form of the Awareness of Independent Learning Inventory (AILI), an instrument developed and used more extensively in Europe (Elshout-Mohr et al., 2004, as cited in Vrugt & Oort, 2008) to measure knowledge of cognition (knowledge of person, strategies, and study tasks), regulation of cognition (planning, monitoring, and evaluation), and responsiveness (representing metacognitive experiences). The results indicated that students' metacognitive knowledge and regulation of cognitive activities contributed to the selection and use of study strategies and two categories of study strategies, metacognitive and resource management strategies, had positive effects on exam performance.

Judgments of Performance

Schraw (2009) outlined a taxonomy of metacognitive judgments of performance, including prospective judgments (before testing), concurrent judgments (during testing), and retrospective judgments (after testing). Researchers employing calibration techniques have used different measures to indicate the goodness of fit between these judgments and actual performance. A key distinction is between absolute accuracy and relative accuracy. Absolute accuracy refers to whether or not a confidence judgment matches performance exactly, providing information about direction and magnitude of error; relative accuracy measures the relationship between confidence judgments and corresponding performance scores using some sort of correlation technique.

Nelson (1999) described three types of prospective monitoring—that is the monitoring of future memory performance. The *Ease-of-Learning Judgment* (EOL) refers to a judgment made before studying. The learner evaluates how easy or difficult an item will be to learn. For example, someone preparing to study a list of French vocabulary might predict that learning "chateau" means "castle" would be easier than learning "boite" means "box." EOL predictions tend to be moderately correlated with actual recall. A second type of monitoring is assessed by a *Judgment of Learning* (JOL), which is a judgment during or soon after study about future recall. The learner predicts the likelihood of remembering an item on a future test. For example, someone might be asked to predict how confident they are that they will be able to recall English translation "box" when given the French word "boite" on a future test. Typically, learners are more accurate in their JOL predictions than in their EOL predictions. Moreover, one consistent finding is that if JOL is delayed (e.g., 5 minutes after study), the delayed prediction is more accurate than immediate JOL (e.g., Nelson & Dunlosky, 1991; see also Rhodes & Tauber, 2011, for a meta-analytic review of this research). The third type of monitoring is assessed by a *Feeling of Knowing* (FOK), which is a judgment of the likelihood of future recognition of currently forgotten information after a recall attempt. Klin, Guzman, and Levine (1997) reported that FOK judgments for items that cannot be recalled are often good predictors of future recognition accuracy. Nelson also described retrospective confidence judgments, which are predictions that occur after a recall or recognition performance. On these tasks, there is a tendency for overconfidence – especially on recognition tasks (Nelson, 1999).

The *Knowledge Monitoring Assessment* (KMA), developed by Everson and Tobias (2001; Tobias & Everson, 2000, 2009), is another prospective measure of the relationship between predicted and actual performance that has been used in a variety of content domains. For example, in studies of vocabulary knowledge, students were given a list of vocabulary words in a content domain and asked to indicate the words they know and those they did not know. This estimate of knowledge was followed by a vocabulary test on the same words. The accurate metacognitive judgments of college students (items they said they knew and did *and* items they said they did not know and did) were positively correlated with standardized measures of language skills and to college GPA. The KMA has also been used to assess metacognitive monitoring of knowledge in other content domains such as mathematics (both word and computation problems) and students at all levels (elementary, middle school, high school, and college) have participated in the studies (Tobias & Everson, 2009).

In summary, this brief review of metacognitive measures supports the conclusion reached by Pintrich, Wolters, and Baxter (2000) in their more extensive review—there is no one "perfect" measure of metacognition. Different instruments measure different aspects of metacognition and all have their strengths and weaknesses. Some measure general metacognitive knowledge and skills, while others focus on metacognition in specific domains, a theoretical and applied issue taken up in the next section. In general, however, we need more longitudinal research designs and research with diverse populations to trace the growth of metacognitive knowledge and skills and to explore potential individual differences. Given the lack of a single generally accepted measure of metacognition, some researchers recommend employing multiple methods, converging dependent measures, and advocate for the empirical investigation of the relationship among different measures (Cornoldi, 1998; Schraw, 2000, 2009).

GENERAL AND DOMAIN-SPECIFIC METACOGNITIVE KNOWLEDGE AND SKILLS

Depending on the field of research and the related definition of metacognition, debate continues about whether metacognitive knowledge and skills are developed in specific domains and then generalized, or whether broad skills are learned and then applied to unique contexts depending on the demands of the learning context, or both. Pintrich (2002) posited that students with general metacognitive knowledge and skills can use those when facing novel classroom tasks, facilitating the transfer of learning. Veenman et al. (2006) hypothesized that students may have broadly applicable general metacognitive knowledge about themselves as learners, what it means to learn, and how to learn something, and that knowledge may then be applied somewhat uniquely within different contexts. In apparent support of a general metacognitive skill, Schraw and Nietfeld (1998) found that college students who were skilled learners seem to have general monitoring skills that they were able to apply across learning contexts. Alternatively, Keleman, Frost, and Weaver (2000) studied memory monitoring in college students across a variety of tasks and found a low correlation for metacognitive accuracy across tasks and high variability in accuracy depending on the task and student ability, suggesting that both individual differences and contextual demands are important factors.

Research findings on the general versus domain-specificity issue have varied depending on which metacognitive knowledge and skills were under consideration, what methods of assessment were used, and the grain of analysis (Veenman et al., 2006). In part, the outcomes have also depended on whether metacognition is understood to be a set of cognitive skills that are a component of intelligence, a completely separate set of cognitive skills, or a somewhat unique set of cognitive skills that are highly correlated with intelligence but also separate (Veenman & Spaans, 2005). Increasingly, the research is suggesting that a combined model is most accurate, with considerable overlap between cognitive and metacognitive skills, but with metacognition providing additional improvement in academic performance above and beyond intellectual ability (Veenman & Verheij, 2003; Veenman, Wilhelm, & Beishuizen, 2004). Thus, there may be highly intelligent students who have not learned or do not use metacognitive strategies, and students with relatively weak cognitive ability who nonetheless use metacognitive strategies to good avail. This distinction may help to explain why there are not stronger correlations between general intelligence and academic functioning (Vrugt & Oort, 2008).

In adolescent and adult learners, metacognitive knowledge seems to be both general and domain specific. Broadly applicable metacognitive knowledge that most students have by the end of high school includes information about effective reading and writing strategies for texts in general (Harris, Santangelo, & Graham, 2010; Hartman, 2001a), and about general memory strategies such as reviewing academic content to increase retention (Schneider, 2010). Pintrich (2002) hypothesized that general metacognitive declarative knowledge domains included rehearsal (repetition to support memorization), elaboration (summarizing, paraphrasing, mnemonic and selection strategies), and organization skills (outlining, concept mapping, and note taking). General conditional knowledge that is applicable across contexts includes knowing when and how to use each specific metacognitive strategy to optimize outcomes (Schraw, Crippen, & Hartley, 2006). Declarative knowledge and beliefs about one's skills in general and in a specific domain area impact behavior as well (Marsh, Martin, & Xu, in press; Zimmerman, 1989).

Procedural knowledge about oneself as a learner also seems to be both general and specific (Carr, 2010). For example, students may have general information about how to study, and may also have more specific knowledge about how and when one needs to study for a math test in ways that are distinct from knowledge about how and when one needs to study for an English exam. To be successful, then, students need knowledge about themselves as learners overall and in specific content areas, as well as how to study both generally and for a specific learning task. College students seem to be able to differentiate between metacognitive knowledge in general—"how most people learn and study"—and knowledge about themselves—"how I learn and study" (Pintrich, Wolters, & Baxter, 2000).

Having knowledge is not enough—in fact, many students have metacognitive knowledge they do not use (Dunlosky, Rawson, & Middleton, 2005; Maki, 1998)—that knowledge must then be appropriately and accurately applied in a relevant learning context. Winne and Nesbit (2010), in a summary of cognitive factors in academic achievement, have suggested that metacognition is a two-step process including initial monitoring of a learning situation, and then making more or less informed choices about subsequent behaviors in the learning process. In Winne and Nesbit's model, metacognition involves being alert to occasions to monitor, having and also choosing appropriate standards for monitoring, accurately interpreting what is being monitored, and having and also choosing appropriate strategies. Additionally, students then must be motivated to act and must create or find a context that allows for strategy implementation. These last two factors are usually considered to be components of self-regulation and not metacognition, however (Winne & Nesbit, 2010).

Cognitive development and experience are generally believed to support increases in general, more global cognitive executive skills and processes such as planning, goal-setting, monitoring, strategy selection, and strategy use. As they develop, students learn new strategies, become more efficient in the strategies they use, and also generally stop using strategies that seem ineffective (Kuhn, 2000; see also Dimmitt & McCormick, in press). But not all students use metacognitive processes. Leutwyler (2009) found that by the last year of high school, 51% of the 1,432 Swiss students in his study reported using planning strategies to learn, 59% used evaluating strategies, and 81% used some form of monitoring strategies. In this study, differences were not observed by socioeconomic status (determined by the number of books in the home) but there were consistent gender differences, with girls reporting higher use of all three metacognitive strategies in both 10th and 12th grade (Leutwyler, 2009). College students also may not exhibit consistent metacognitive knowledge or strategy use (Hofer, Yu, & Pintrich, 1998; McCabe, 2011). Moreover college students may or may not be aware of strategies, and if aware, may not have the expertise to effectively use them (Justice & Dornan, 2001).

Students with general metacognitive knowledge and skills are more able to apply active learning strategies in a variety of academic contexts and when faced with an unfamiliar learning task (Pintrich, 2002; Schraw, 2001), which becomes increasingly important in secondary and post-secondary learning environments. As academic domains become increasingly differentiated, task demands, learning processes, and assessment of learning become more domain specific. For example, studying for an English test may call for the use of memory strategies for vocabulary words, while studying for a calculus exam may require practicing calculation. Both may require monitoring for comprehension, review of material, and decisions about whether the content is adequately mastered. For these reasons, Baker and Beall (2009) suggested that students need to learn both general and domain-specific metacognitive skills, with the latter embedded in the relevant context in order to support learning.

Of particular interest to educators are questions about how students develop the metacognitive knowledge and skills relevant to academic success both across and within learning domains, what helps students choose to use the skills they have, and how to teach these skills effectively. The next few sections of this chapter will summarize the relevant research in these areas, starting with reading comprehension skills, which are a foundation for many learning tasks.

Metacognition and Reading

Reading is a complex and multidimensional process that requires phonemic awareness, decoding, fluency, word recognition, use of prior word and world knowledge, active comprehension strategies, and monitoring (Pressley, 2006). Once basic reading fluency skills are achieved, effective readers approach the task of reading knowing and being able to use a range of strategies. They know how to read effectively, can identify the purpose of reading, and know how to make sure they understand and then remember what they have read (Kamil, Mosenthal, Pearson, & Barr, 2000; National Reading Panel, 2000; Pressley & Afflerbach, 1995), all of which are metacognitive components of the task. Research using the think-aloud protocol has demonstrated that as skilled readers read they enter texts with some predictions about the content based on context variables such as setting and prior related knowledge (Pressley, 2003). While reading, effective readers also can recognize when they do not understand the content, generate questions, adjust their strategies accordingly, and realize when they need to ask for help (Otero, 2009; Pressley, 2003). When they are done reading, they can summarize what they have read, make inferences, and think about how to use the ideas in other contexts (McKeown & Beck, 2009; Pressley, 2003). Conversely, reading research has shown consistently that when students read without using these metacognitive strategies they are less likely to understand what they have read (Brown, Armbruster, & Baker, 1986; Dunlosky & Lipko, 2007), are more likely to misinterpret the content (McKeown & Beck, 1994) and are less likely to remember what they read (Griffin, Wiley, & Thiede, 2008).

A complete summary of the research on the development of students' knowledge and use of metacognitive processes in reading is beyond the scope of this chapter, and has been done elsewhere (see National Reading Panel, 2000; Pressley, 2005; see Pearson, this volume). Initial reading research assumed that more sophisticated metacognitive strategies developed only after early skills such as decoding had reached fluency, but increasingly there is consensus that even very early readers (age 4) are capable of using metacognitive comprehension strategies such as monitoring for meaning, that their strategy use can be supported by parent and teacher modeling and suggestion, and that over time most students use a wider variety of strategies (Williams & Atkins, 2009).

Reading research, however, has found consistent differences in metacognitive knowledge and strategy use between more and less skilled readers, with many, but not all, skills developing over time. Stronger sixth grade readers have more knowledge about strategies for monitoring and comprehension than weaker readers the same age (Myers & Paris, 1978). This study also found age-related differences, with 12-year-old students more sensitive to different goals of reading, to the structure of paragraphs, and to strategies used to resolve comprehension failures than 8-year-olds. Poor readers are more passive in their approach to the task (Haines & Torgeson, 1979), have less understanding of the purpose of reading (Paris & Jacobs, 1984), and may not be aware that they are not accurately comprehending the text they are reading (Garner, 1987). Stronger readers can identify when they need to use additional reading strategies, have ideas about what strategies might help in a variety of contexts, and are more likely to use those strategies (Pressley, 2000).

For secondary level students, reading skills develop in relation to prior competencies and become increasingly automatic, although that automaticity does not necessarily mean better monitoring or comprehension (McKeown & Beck, 2009). Skilled secondary readers use more metacognitive strategies and they use them more often than less skilled and younger students, consciously engaging with texts in a variety of ways. Skilled readers have declarative, procedural, and conditional metacognitive knowledge and use that information to figure out unfamiliar texts, to correct misunderstandings, and to change speed in order to facilitate comprehension (Mokhtari & Reichard, 2002; Pressley, 2006). They use a variety of planning strategies to establish their goals for reading, to monitor whether their strategies are working and their goals are being met, to self-evaluate their comprehension and make adjustments accordingly, and to seek help if needed (Afflerbach & Meuwissen, 2005; Baker, 2008).

Theoretically, college students are proficient readers who can understand and use ideas presented in increasingly complex texts. Content at this level is often context-specific, and may require specialized vocabulary and context knowledge for comprehension. Students who set reading goals and actively use reading comprehension strategies such as looking for the main idea in a text, summarizing, generating questions, note taking and underlining had higher GPAs in college (Taraban, Rynearson, & Kerr, 2000). Students who successfully use metacognition are able to accurately identify the learning context demands, set goals accordingly, choose specific learning/studying behaviors to enact that they believe will help them reach their goals, self-monitor their success in moving toward their goals and meeting the demands, change their strategies when what they are doing doesn't work, and determine whether they have reached their goals (Winne & Nesbit, 2010).

Calibration techniques, described earlier, have been used to assess metacognition related to the comprehension of textual material, although judgments about the complex task of learning connected discourse are generally less accurate than those associated with the more simple task of paired-associate learning (Pieschl, 2009). Calibration of comprehension, sometimes termed metacomprehension, is operationalized by relating readers' predictions of comprehension with actual performance on a test. High correlations indicate good metacomprehension; low correlations indicate poor metacomprehension. In a typical study using this paradigm, Maki and Berry (1984) asked college students to read paragraphs from an introductory psychology text. After reading each paragraph, the students predicted (on a Likert-type scale), how well they would perform on a multiple-choice test. For the students who scored above the median (the better learners), the mean ratings of material related to questions answered correctly were higher than ratings of material related to questions answered incorrectly. Students are more accurate in their calibrations of comprehension when more test questions are provided per prediction (Weaver, 1990) and when asked to make multiple judgments (Weaver & Bryant, 1995). Although delayed predictions and delayed tests produce the highest prediction accuracy in paired associate learning, the classic Delayed Judgment of Learning effect (JOL) described earlier, immediate predictions and immediate tests produce the greatest prediction accuracy with text material (Maki, 1998).

Maki (1998) reported that the mean gamma correlation between predictions of test performance and actual test performance across many studies (more than 20) emanating from her lab was .27, a low level of relative accuracy. Moreover, the metacomprehension accuracy of college students varies by the type of text being read (Maki, Shields, Wheeler, & Zacchilli, 2005; Wiley, Griffin & Thiede, 2005). Zhao and Linderholm (2008) explored potential explanations for limits on metacomprehension suggesting that learners judge future comprehension performance by starting with an anchor (performance expectations based on past history) and adjust that performance expectations as a result of experience with the task at hand.

Retrospective judgments of learning have also been studied with textual material. Glenberg and Epstein (1985) asked college students to rate how well they would be able to use what they learned from textual material to draw an inference. They found that the only judgments more accurate than chance were postdictions (those made after responding to the inference questions). Pressley and Ghatala (1990) also found more accurate predictions of learning after testing, something they called the "testing effect." Similarly, Maki (1998) reported that many studies indicate that predictions made after taking a test (postdictions) were more accurate than predictions preceding a test (see also Pieschl, 2009).

Researchers have identified individual variation in the metacomprehension accuracy of college students (Chiang, Therriault, & Franks, 2010). Student characteristics, such as verbal ability, have an effect on prospective and retrospective judgments of learning. For example, Maki, Shields, Wheeler, and Zacchilli (2005) asked students who varied in verbal ability to predict future performance both before test and after test. On hard tasks, the students with lower verbal ability were overconfident; students with higher verbal abilities were underconfident about past performance. Metacomprehension accuracy also varies with student performance in undergraduate courses. Hacker, Bol, Horgan, and Rakow (2000) studied undergraduate students in a semester-long course. High-performing students were accurate and their accuracy improved over the semester. Low-performing students exhibited moderate prediction accuracy but good postdiction accuracy and they were generally overconfident in their predictions and postdictions. Hacker, Bol, and Bahbahani (2008), studying calibration in an undergraduate educational psychology course, also found that higher performing students were accurate in their predictions and did not find significant improvement in accuracy over the semester. Lower performance students were less accurate than higher performing students in their calibration and when provided with extrinsic incentives, showed improvement during the semester. Miller and Geraci (2011) studied college students' predictions of their performance on course exams and their confidence in these predictions. In comparison to high performing students, the lower performing students were more overconfident in their predictions (predicting higher performance than their actual performance) but were less confident in their predictions, thereby indicating that they had some inkling that they had been overconfident.

Metacognition and Writing

The very act of writing itself has recently been hypothesized to be a process of applied metacognition (Hacker, Keener, & Kircher, 2009). These authors defined writing as "the production of thought for oneself or others under the direction of one's goal-directed metacognitive monitoring and control, and the translation of that thought into an external symbolic representation" (Hacker et al., 2009, p. 154). According to this paradigm, writing is textual, cognitive, and social, and it is both a process and a product. Writing is an "act of meaning production" (p. 157) that involves use of metacognitive monitoring strategies through "reading, re-reading, reflecting, and reviewing" (p. 157) and the use of metacognitive control strategies through "editing, drafting, idea generation, word production, translation, and revision" (p. 157). Hacker et al. (2009) argued that the explicit and implicit use of these strategies is both a metacognitive process and what translates one's thoughts into writing—hence, writing as applied metacognition.

Using think-aloud protocol analysis, Hayes and Flower (1980; Flower & Hayes, 1981), developed an early model of the role of metacognition in writing. They described writing as a recursive, interactive, goal-directed thinking process involving *planning*, *translating* ideas and images into words, *reviewing* what has been written, and *monitoring* throughout the process. Flower's revision of this model has focused on the process of creating meaning through interpretation, negotiation and reflection (Flower, 1994). Hayes' revisions have focused on content comprehension, the role of affect and motivation, writing task definition, the evaluation, revision and interpretation of text, and the role of memory resources (Hayes, 1996, 2006). Hacker et al. (2009) argue that the writing process is less hierarchical and more constantly recursive than the original Hayes and Flower model, and that the very act of writing requires continuous active control and monitoring processes.

Scardamalia and Bereiter (1986; Bereiter & Scardamalia, 1987) generated another influential theoretical model that posited that writing involves creating a mental representation of the writing task, problem analysis and goal-setting, problem translation, and composing. This model differentiates between two broad strategies for composing: knowledge telling and knowledge transforming. In *knowledge telling*, a strategy used more often by novice writers, what is known about a topic is presented in a paper until the supply of knowledge is exhausted. In *knowledge transforming*, used by more expert writers, the writer consciously reworks the text—diagnosing problems, planning solutions, and monitoring the effectiveness of solutions.

Since this early theorizing, much writing research has focused on the differences between more and less skilled writers, in order to both explicate writing processes and to determine how to teach students how to write more effectively (Graham, 2006). This research has consistently found that effective writers have a repertoire of metacognitive knowledge and control strategies that aid them in every aspect of the writing process (Harris, Graham, Brindle, & Sandmel, 2009; Sitko, 1998). Good writers carry out advance planning, organize their ideas and text, have more understanding of the writing process, and have strategies for drafting and revising their writing—ultimately creating more coherent, polished, articulate and effective texts (Harris et al., 2009).

Metacognition and Problem Solving in Science and Mathematics

Effective problem solving is another academic activity that has been consistently found to require considerable metacognitive knowledge and skill (Carr, 2010; Davidson & Sternberg, 1998). In Davidson and Sternberg's (1998) model of general problem solving, the critical first step is to define what the problem is, including the formation of a mental representation that would be helpful to solving the problem. An effective mental representation allows the problem solver to organize and combine information (thus decreasing memory demands), to monitor solution strategies, and to allow generalizations across problems. A mental representation that encourages generalization would be based on essential, rather than surface, features of the problem. After problem definition, an appropriate solution strategy must be selected and then monitored as it is implemented. If there are obstacles to solving the problem, they must be identified and addressed. Experts in a specific domain spend proportionately more time analyzing, planning, and determining possible strategies than do novices (Schoenfeld, 1987), and their problem representations tend to be more abstract than those of novices (Davidson, Deuser, & Sternberg, 1994).

Some researchers have argued that metacognitive processes are involved in almost every aspect of problem solving in mathematics (Desoete, 2009). In math, metacognitive skills are needed in order to apply a learned strategy to new but related problems, to make predictions (a version of goal setting), to monitor and to judge the appropriateness of a chosen strategy and to make different strategy choices when necessary (Desoete). More proficient math students are more likely to use metacognitive strategies to solve problems and reason (Lucangeli & Cornoldi, 1997), to solve word problems (Teong, 2002), and to determine whether they know how to do specific kinds of math questions (Desoete & Roeyers, 2006).

Science is another academic discipline where metacognitive knowledge and strategies, especially in problem solving, have proven to be critical. Scientific learning and exploration, especially inquiry based learning, is often conceptualized as particularly related to metacognitive processes (Schraw et al., 2006; White, Frederiksen, & Collins, 2009). White and Frederiksen (1998, 2005) developed a model of scientific inquiry that integrates theory and empirical investigation, with four interrelated and recursive components, each with metacognitive features. *Meta-theoretic knowledge* involves information about the scientific theories and models (including structural, causal, and dynamic models) used to guide inquiry, as well as "how theories and models are created, refined, and coordinated" (White et al., 2009, p. 180). *Meta-questioning knowledge* entails understanding a wide range of research questions, and how scientific questions contribute to the expansion of existing theories and models and to the development of new ones. Meta-questioning knowledge also includes hypothesis-generation, and the awareness of the complex relationships among scientific questions *meta-investigation knowledge* subsumes information about the forms of scientific investigation, including both exploratory (inductive) investigations and confirmatory (hypothetico-deductive) investigations of hypotheses. Included in this is attentiveness to the strengths and weaknesses of each kind of investigation. *Meta-knowledge for data analysis* includes information about "(a) the representation of data, (b) the confirmation or refutation of existing hypotheses, (c) the induction of new hypotheses, and (d) generalization" (White et al. 2009, p. 183).

INSTRUCTIONAL INTERVENTIONS

Metacognitive awareness and skills are a central part of many academic tasks, leading to a critical question for educators about how we foster the development of metacognition in students. Veenman et al. (2006) identified three principles for successful metacognitive instruction: “a) embedding metacognitive instruction in the content matter to ensure connectivity, b) informing learners about the usefulness of metacognitive activities to make them exert the initial extra effort, and c) prolonged training to guarantee the smooth and maintained application of metacognitive activity” (p. 9).

Research on metacognitive instruction has been conducted at multiple levels—with individual students, at the classroom level through curriculum, and at the classroom level through general teaching practices. According to Paris and Winograd (1990), the cognitive reflection required to develop sophisticated metacognition can “come from within the individual or from other people” (p. 21). Thus, researchers have explored techniques for fostering metacognition that involve solo learners and that utilize interactions between learners to encourage the development of metacognitive thought. Research has also been across contexts, including laboratory settings, in actual classrooms, and with computers. What has become increasingly clear is that students need to learn multiple strategies (although not so many as to be confusing, Pressley, 2000), to be able to use strategies alone and with others, and to have awareness of the contextual demands that are the best match for each specific strategy (Baker, 2002; Gajria, Jitendra, Sood, & Sacks, 2007; National Institute of Child Health and Human Development, 2000). What follows is a description of successful educational interventions with middle school and high school students and then with college students.

Middle School and High School Students

Because metacognition involves consciousness of one’s own thinking, instructional interventions have focused on strategies designed to make cognitive content and processes more accessible and explicit, especially in the core skills of reading, writing and problem-solving. Explicit instruction in metacognitive strategies increases student use (Bransford, Brown & Cocking, 2000; Schneider & Pressley, 1997), and increased use leads to greater engagement in both academic and nonacademic learning (Zimmerman, 2001) as well as to better academic outcomes (Brown, 1997; Tobias & Everson, 2009).

A full discussion of the extensive body of research about metacognitive strategy instruction that improves reading comprehension skills is beyond the scope of this chapter. There is evidence that teaching students methods for making thinking processes more visible and concrete, such as self-instruction (Miller, Giovenco, & Rentiers, 1987) thinking aloud (Baumann, Seifert-Kessel, & Jones, 1992), and self-explanation (McNamara & Magliano, 2009) are effective. In addition, reading intervention programs such as *Self-Explanation Reading Training* (SERT; McNamara, 2004) and *Interactive Strategy Training for Active Reading and Thinking* (iSTART; McNamara, O’Reilly, Best, & Ozuru, 2006) have been designed to promote self-explanation and other metacognitive reading strategies including monitoring comprehension, making bridging inferences, paraphrasing, predicting, and elaborating (McNamara & Magliano, 2009). Several studies have demonstrated positive outcomes for the SERT and iSTART interventions with high school and college students, with stronger results for students with less prior knowledge and measures of comprehension that were more text-based (McNamara & Magliano, 2009; O’Reilly, Best, & McNamara, 2004).

Teaching specific strategies can have an impact, but increasingly programs designed to improve reading and comprehension either teach multiple metacognitive strategies or teach how to metacognitively monitor and regulate several related cognitive strategies (Williams & Atkins, 2009). One of the first such programs was Informed Strategies for Learning (ISL) (Paris, Cross, & Lipson, 1984; Paris & Jacobs, 1984), which was designed to teach students specific regulation strategies through modeling, discussion, and scaffolded guided practice. Another early method was reciprocal teaching (RT), an instructional model designed for teaching comprehension strategies in the context of a reading group (Brown & Palincsar, 1989; Palincsar & Brown, 1984). In RT students learn to make predictions during reading, to question themselves about the text, to seek clarification when confused, and to summarize content. The teacher models the process, then students provide peer modeling for each other. The underlying premise is that by participating in this group learning process, students eventually internalize the strategies, and the evidence is that reciprocal teaching is generally effective (Rosenshine & Meister, 1994).

The “Questioning the Author” (QtA) method of reading comprehension and comprehension-monitoring development is based on cognitive processing models more than strategy instruction per se (Beck & McKeown, 2006; McKeown & Beck, 2009). QtA uses open questioning by teachers to facilitate engagement with the content of a text, and particularly the most salient ideas, in order to facilitate comprehension. It is designed to help students generate mental models about ideas in a text in order to facilitate comprehension, with a focus on reading content rather than specific cognitive strategies. Studies at the elementary and middle school level have found that QtA helps students seek connections, build meaning, and articulate ideas about complex texts, with related increases in both comprehension and comprehension-monitoring (Beck & McKeown, 2006; McKeown & Beck, 2009).

King (1997, 1998, 2002) developed the ASK to THINK—TELWHY®© model of peer tutoring to promote reciprocal inquiry to foster skill development in asking deep questions, answering questions in order to develop one's own and others' learning, building on another's response, and assessing one's own and others' understanding and comprehension. In addition to supporting comprehension and monitoring of text, metacognitive questions in this model develop explicit identification of strategy use, and help learners to identify possible retrieval and memory cues for subsequent use of the material (King, 2002).

The research on reading comprehension strategy instruction has demonstrated that instruction impacts several student outcomes, and that metacognitive skills can be improved. Questions remain about which specific strategies or groups of strategies are most effective in varying learning domains, for learners of each age, for learners with differing abilities, for types of text, and for the difficulty of the text involved.

Effective writing instruction also includes components related to the development of metacognition. Graham and Perin (2007) conducted a meta-analysis of writing instruction methods for adolescents and concluded with 10 research-based recommendations, several of which involve metacognitive processes such as planning, revising and editing compositions, and summarizing reading material. The results of the meta-analysis demonstrated that metacognition is a significant factor in writing, and that strategies instruction can improve writing and the related metacognitive components that underlie effective writing (Graham & Perin, 2007).

One of the most widely researched metacognitive strategy instruction models in writing is Self-Regulated Strategy Development (SRSD; Graham & Harris, 2003; for a review see Harris et al., 2009), which has been studied for over 20 years. There are six stages to the model: Teachers activate and develop student background knowledge; discuss the writing processes and strategies to be used in each writing task; explicitly model each stage of the writing process (generating ideas, planning, organizing ideas, writing, and revising) and related strategies for success (through think alouds or other demonstration of metacognitive processes); provide time and memory strategy for students to memorize the writing strategies; provide scaffolded support of use of the strategies through guided practice, and; provide opportunities for students to perform independently (Harris, & Graham, 1992).

SRSD has been found to be effective with writers with a range of skills, in a variety of writing genres, and from grades 2 through 10. SRSD generates significant improvement in "development of planning and revising strategies, including brainstorming, self-monitoring, reading for information and semantic webbing, generating and organizing writing content, advanced planning and dictation, revising with peers, and revising for both substance and mechanics" (Harris et al., 2009, p. 145). The key components of the SRSD model identified by Harris et al. (2009) are that self-regulation and writing strategies are explicitly taught, students actively collaborate in their learning, instruction is modified based on learners' needs, students are self-paced, with mastery as the goal, and instruction occurs over time, with new strategies introduced and known strategies reinforced.

Metacognitive strategy instruction has also produced impressive gains in student outcomes in scientific reasoning (Zohar & Peled, 2008), scientific inquiry skills (White & Frederiksen, 2005) and scientific literacy (Michalsky, Mevarech, & Haibi, 2009), which in this study was defined as the ability to access prior knowledge, ask questions and draw conclusions from scientific texts. In mathematics, metacognitive strategy instruction in self-questioning, problem-solving and monitoring can improve student learning outcomes (Delclos & Harrington, 1991; Fuson, Kalchman, & Bransford, 2005; King, 1991).

College Students

Moving from a high school to a college learning environment triggers many academic challenges. At the college level, students are more often required to use and demonstrate higher order thinking skills, to be able to use new knowledge and not just remember information, to be independent learners, and to match their learning behaviors to the task demands. Successful college students are more likely to possess metacognitive skills such as the capacity to know when they have not adequately learned course material, to match their studying activity to the demands of the assessments of learning, and to estimate their understanding accurately (Hacker et al., 2000; Isaacson & Fujita, 2006).

Research has demonstrated that even sophisticated learners can misjudge or inaccurately interpret the demands of a learning situation (Carroll, 2008; Garner & Alexander, 1989; Kruger & Dunning, 1999), that students who use metacognitive strategies are more likely to be successful in college (Everson & Tobias, 2001) and that education about metacognition and metacognitive strategies can increase student learning and related achievement (Bransford, Sherwood, Vye, & Rieser, 1986; Zimmerman & Moylan, 2009). Moreover, even proficient college-level readers can benefit from reading instruction (Lei, Rhinehart, Howard, & Cho, 2010) especially regarding comprehension (McNamara & Magliano, 2009).

Dunlosky and Lipko (2007) summarized investigations of how metacomprehension performance in college students can be improved. With college students, rereading is one strategy that has been found to improve both comprehension accuracy (Rawson, Dunlosky, & Thiede, 2000) and immediate recall (Roediger & Karpicke, 2005). Summarizing texts during reading and generating key terms representative of the text while reading have also increased the metacomprehension accuracy of college students (Thiede & Anderson, 2003; Thiede, Anderson, & Therriault, 2003; Thiede, Dunlosky, Griffin, & Wiley, 2005). Other effective techniques for increasing text comprehension monitoring and retention include responding to questions inserted in text (Pressley, Snyder, Levin, Murray & Ghatala, 1987) and self-testing, via writing about content just read (Roediger & Karpicke, 2005).

Other researchers have explored techniques that utilize interactions between learners to encourage the development of metacognitive skills. Based on a theoretical model of dyadic cooperative learning focusing on the acquisition of cognitive (C), affective (A), metacognitive (M), and social (S) skills (CAMS), O'Donnell, Dansereau, Hall, and Rocklin (1987) asked college students to read textual material working in scripted dyads, in unscripted dyads, or as a group of individuals. Scripted dyads were given instructions in how to interact with their partners. Specifically, they were taught to take turns as they read, having one person summarize the text section while the other tried to detect errors and omissions in the summary. O'Donnell et al. found that students who worked in dyads recalled more of the texts than individuals did. Scripted dyads, however, demonstrated greater metacognitive awareness in that they were more accurate in rating their performance than were the other students.

The think-aloud method has been used successfully in mathematics instruction, using a cooperative peer-learning model that resembles reciprocal teaching (Whimbey & Lochhead, 1986). One person reads a problem and solves it, saying steps in the process out loud. The other person listens and monitors the problem-solver's process. The monitor checks for accuracy, asks questions and identifies errors. The learners take turns in each role, developing skills in both problem solving and monitoring. Schoenfeld (1985) also developed a method for improving metacognitive skills during mathematical problem solving. Students are instructed to methodically break down and simplify problems, generate possible solutions or new ways of understanding it, and then identify solutions. At each step of the process, the students are taught monitoring and evaluating strategies so that they can self-evaluate their process and outcomes, resulting in significant improvement in students' problem-solving skills, more frequent self-monitoring while working, and more facility with novel problems.

Schraw, Crippen, and Hartley (2006) reviewed instructional strategies in science and identified six general areas that promote metacognition or other aspects of self-regulated learning: inquiry-based learning (students actively generate hypotheses and generate solutions), collaboration among students and teachers, strategy instruction (in cognitive, problem solving, and critical thinking strategies), developing mental models and awareness of conceptual change, the use of technology, and increasing awareness of student and teacher beliefs and their impact on science education.

Although the research instruction designed to foster metacognition is promising, it is important to keep in mind that there are consistent discrepancies between what students know is most effective and what they actually do. Karpicke, Butler, and Roediger (2009) found that even when students knew the more effective study strategy of active recall (a version of self-testing and retrieval) most of them chose to reread, which is a less impactful method. They theorized that students have illusions about their competence and make choices about study habits that reflect that overestimation of their ability and knowledge. Rereading suggests an illusory ease with the learned content that leads to inaccurate assumptions of knowledge and capacity to recall content. The more effective strategy required active recall that is more similar to a testing requirement, and so is a more accurate self-assessment of what is known.

Finally, in a study examining both metacognitive awareness and instructional methods to increase that awareness in an applied college classroom context, McCabe (2011) first asked college students to judge the effectiveness of six empirically validated effective learning strategies as described in learning scenarios derived from research and found that students were not able to accurately predict the effectiveness of most of the strategies (except for a “weak endorsement” of the strategy of generating study materials). Performance on this task was, however, correlated with the metacognitive regulation subscale of the MSLQ described earlier. In a second study, McCabe examined different levels of instruction on the effectiveness of the strategies and found that students who had received some kind of targeted instruction on applied memory topics in their psychology courses (in a single lecture, in a cognition course with ongoing discussion of the topics, or in a seminar where original research about the six empirically validated strategies was discussed) exhibited higher prediction accuracy than control students or students who participated in the first study. The students who were the most accurate were the ones who read and discussed the relevant research. McCabe reached the following conclusion: college students’ awareness of the effectiveness of strategies is relatively low and “educational intervention, in the form of targeted instruction on learning and memory topics, may have the potential to improve metacognitive awareness of factors associated with academic success” (p. 474).

LEARNING ENVIRONMENTS TO PROMOTE METACOGNITION

In addition to investigating the effectiveness of researcher-designed instructional interventions as reviewed in the previous section, researchers have also examined the characteristics of learning environments that promote the development of metacognitive knowledge and skills. Much of this work has focused on teacher-led learning environments, the more typical classroom context, resulting in an initial emergent understanding of the teacher behaviors that foster growth in metacognition. This work on teacher-led learning environments is complemented by preliminary explorations of how to best designed computer-based learning environments to support metacognition. Research focusing on teacher-led and computer-based learning environments is summarized in turn.

Teacher-Led Learning Environments

Teachers can use metacognition to improve their teaching processes and to create learning environments that are conducive to metacognitive skill development in students. Teaching metacognitively includes both “teaching *with* and *for* metacognition” (Hartman, 2001b, p. 149) and each of these approaches is elaborated below.

Teaching for Metacognition

When teachers “think about how their instruction will activate and develop their students’ metacognition, or thinking about their own thinking as learners” that is teaching *for* metacognition. Such teaching “for” activities include planning, scaffolding, reflective questioning, providing timely feedback, modeling, explicit strategy explanation, and promoting collaborative learning and peer tutoring (Bransford et al., 2000; Hartman, 2001a). Teachers can also provide students with instruction in learning activities that support metacognitive development, such as setting goals, learning study strategies, analyzing errors, generating questions, organizing ideas, creating graphic organizers and evaluating work (Zimmerman & Moylan, 2009). Bransford et al. (2000) theorized that a metacognitive classroom environment is learner-centered, designed to promote student engagement and learning, and supports increasing amounts of student self-direction and self-regulation. Students in this context are challenged with complex tasks that build on prior knowledge and that require active and strategic learning and metacognitive deliberation (Bransford et al., 2000; Brown, 1997).

Sitko (1998) described the overall theme of metacognitive instruction as “making thinking visible.” To this end, she suggested incorporating introspection, on-line thinking-aloud protocols, and retrospective interviews or questionnaires into classroom practice. Fusco and Fountain (1992) provided a shopping list of teaching techniques that they suggest are likely to foster the development of metacognition, including extended wait time, metacognitive questions, concept mapping, writing in journals, and think-aloud techniques in cooperative groups. They cautioned, however, that “unless these self-reflective strategies become a part of daily classroom tools, there is little chance that they will become students’ strategies” (p. 240). Winograd and Gaskins (1992) emphasized that “metacognition is most likely to be invoked when individuals are pursuing goals they consider important” (p. 232). Thus, they argued for authentic activities and thoughtful assessment in classrooms. In addition, they recommended a combination of teaching methods, including cooperative learning and direct explanation for strategy instruction (Duffy & Roehler, 1989; Roehler & Duffy, 1984). Formative assessments that allow for immediate feedback and correction as well as self- and peer-assessments in addition to teacher assessments provide a variety of perspectives on students’ work (Brown, 1997).

Schraw (2001) encouraged teachers to use an instructional aid he calls the Strategy Evaluation Matrix (SEM) for the development of metacognitive knowledge related to strategy instruction. In this matrix, students list their accessible strategies and include information on How to Use, When to Use, and Why to Use each strategy. The idea is to foster the development of explicit declarative, procedural, and conditional knowledge about each strategy. In classroom practice a teacher can ask students to complete a SEM for strategies in their repertory. Then the students can compare strategies in their matrix and compare their SEM to the matrices of other students. Schraw conceptualized the SEM as an aid to improve metacognitive knowledge and proposed the Regulatory Checklist (RC; modeled after King, 1991) for improving metacognitive control. The RC is a framework for self-questioning under the general categories of planning, monitoring, and evaluating. Schraw emphasized that providing students with the opportunity to practice and reflect is critical for successful implementation of these instructional aids.

Meichenbaum and Biemiller (1992) proposed that educational growth in a particular skill or content domain has two dimensions: the traditional curriculum sequence or "basic skills" dimension and the dimension of "classroom expertise," where students overtly plan, monitor, and evaluate their work. To foster growth in the second dimension (the development of metacognition), they advised teachers to pay attention to pacing, to explicit labeling of task components, and to clear modeling of how to carry out tasks and problem solve. They cautioned that students should engage in tasks that vary along a range of complexity. Tasks that are too simple will not require extensive metacognitive processing, and excessively complex tasks will inhibit a student's ability to self-talk metacognitively or to talk to others due to limits of attentional capacity.

Ritchhart, Turner, and Hadar (2009) found that when classroom teachers (grades 3 to 11) consistently modeled the process of making their own thinking more transparent that their students' thought processes (as measured by concept maps about thinking) became more sophisticated and intentional, above and beyond expected changes due to maturation and development. Collaborative engagement with peers, especially when it is carefully set up with established questions, roles, and goals, has been found to be conducive to learning (Duffy, Miller, Parsons, & Meloth, 2009; Whitebread, Bingham, Grau, Pasternak, & Sangster, 2007) and can be motivating and engaging for students (Zimmerman & Moylan, 2009).

A line of research conducted by Duffy and his colleagues (Duffy, 2002; Duffy et al., 1986; Duffy et al., 1987) identified direct explanation of strategies by teachers as a key component of metacognitive strategy instruction in reading comprehension. The initial part of the intervention was teacher training in the use of direct explanation and subsequently teachers taught students the strategies, and talked about why and when they were useful. Teachers who were trained in strategy explanation were more specific in what and how they taught reading strategies, and their students showed greater declarative and procedural metacognitive knowledge (Duffy et al., 1986; Duffy et al., 1987).

The direct explanation of strategies is also a critical part of the Transactional Strategies Instruction (TSI) program developed by Pressley and colleagues (Brown, Pressley, Van Meter, & Schuder, 1996; Pressley, 2002b). This model starts with providing teachers with training in how to teach reading comprehension strategies, facilitate collaborative peer dialogue about strategy use, motivate students to use the strategies by making personal links to the text content, and support eventual independent strategy use by students. TSI has been found to impact reading comprehension on the Stanford Achievement Test (Brown et al., 1996), which is a rare finding for outcome studies of metacognitive reading strategy instruction (Williams & Atkins, 2009). In addition, TSI seems to support students' positive identification of themselves as readers (Casteel, Isom, & Jordan, 2000).

Teaching With Metacognition

When teachers "think about their own thinking regarding instructional goals, teaching strategies, sequence, materials, students' characteristics and needs, and other issues related to curriculum, instruction and assessment before, during and after lessons in order to maximize their instructional effectiveness" that is teaching *with* metacognition (Hartman, 2001b). Duffy, Miller, Parson, and Meloth (2009) recently suggested after a thorough review of research on teachers' metacognitive thought processes that the most effective teachers "frequently and deliberatively engage in conscious, mindful action (or, as we argue, in metacognitive thought) as well as technical or procedural routines" (p. 241). According to these researchers teaching requires all of the metacognitive knowledge, skills and strategies used by effective learners, and while teachers are engaged in this thinking about their own thinking and actions they must simultaneously also be aware of and make decisions about how to support the development of the thinking and learning of their students—a demanding set of tasks.

In describing the problems inherent in identifying and measuring teacher metacognitive processes, Duffy et al. (2009) articulated the following challenges: confusion and overlapping constructs in definitions of metacognition in teacher education, the inherent complexity of the teaching task and context and related measurement, the routinization of many metacognitive tasks (especially by experienced teachers), external institutional and legislative requirements that impact teacher behaviors, and, finally, the methodological difficulties accessing intuitive thought, concurrently and retrospectively. In other words, the assessment challenges articulated earlier in this chapter are compounded by the demands of teaching.

Duffy et al. (2009) argued that several teacher activities, including planning, decision-making, scaffolding, and assessing learning are inherently metacognitive, although the thought processes of teachers engaged in these behaviors are not well researched, and there is little evidence of an impact on student outcomes. Studies of effective teachers and classrooms have indicated that planning for instruction, setting learning objectives, determining effective techniques to meet the objectives, and selecting methods for measuring whether students have learned what was intended all lead to substantial benefits for teachers and students (Berliner, 2004; Pressley, 2002a). At the same time, being able to be flexible, responsive to individual learner's needs, and spontaneous are all part of successful teaching (Morrow, Tracey, Woo, & Pressley, 1999). Additionally, teaching for student metacognitive development using think-aloud modeling, direct instruction of strategies, and scaffolding of learning require pedagogical understanding of metacognition (Wilson & Bai, 2010).

Wilson and Bai (2010) surveyed 105 graduate students preparing to be teachers using the Teacher Metacognition survey created for their study. They found that the graduate students knew that instructional strategies support the development of student metacognition, were aware that metacognition and teaching metacognition are active processes requiring engagement and practice, and valued many metacognitive pedagogical approaches such as demonstration, scaffolding, and explicitly teaching strategies. A structural equation model found that there were complex and significant relationships among participants' conditional, declarative and procedural metacognitive knowledge. All three types of knowledge also were related to pedagogical knowledge of metacognition. The researchers identified some contradictions between what the students knew about how to support metacognitive skill development and what they reported about how they planned to teach.

Based on their outcomes, Wilson and Bai (2010) questioned whether there is a tension between what their study participants knew they should do (teach with and for metacognition) and recognition of what they have seen done and actually do themselves in the classroom. They suggested that teaching metacognitively does not fit easily into educational contexts where there is pressure to cover a certain amount of content, and conclude, "These teachers appeared to have an academic understanding of what is necessary for teaching students to be metacognitive, but they also seem to value activities that are not highly correlated with helping students to be metacognitive" (p. 286).

If effective teaching, and particularly effective teaching for student metacognitive skill development, requires metacognitive awareness and skill in teachers, a key question is what education and professional development methods will facilitate development (Duffy et al., 2009; Wilson & Bai, 2010; see also Whitcomb in this volume). Some recent strategies that have shown promise include promoting metacognitive reflection in order to promote active engagement in and responsibility for learning (C. Glava & Glava, 2011), and concept mapping and Vee diagramming (Palak, 2011). Duffy et al. (2009) highlight the need for more research about how and when teachers are metacognitive, how teacher metacognition is related to student achievement, and how to provide both preservice and inservice teachers with effective education about metacognition—their own and their students'.

Metacognition in Computer-Based Learning Environments

Researchers are interested in exploring whether and how computer-based metacognitive scaffolds can be useful in improving overall student learning in computer-based learning environments (CBLEs) at the middle school, high school and college levels (Goldman, this volume). This research is motivated by the increasing ubiquity of computers in educational settings and society at large, as well as the belief that computers can serve as cognitive tools to improve teaching and learning in many domains. Ultimately this research could lead to efficient and cost-effective ways to optimize student performance in a variety of learning situations, including those in which a competent human tutor is not available (e.g., in online learning courses, while undertaking homework, and/or in large classes) or where computer-based learning plays a prominent role (e.g., lab settings). Additionally, this research may prove helpful in addressing the achievement gap in education. For example, as computers become more and more available in school settings and access to CBLEs increases, all students may have the opportunity to become better learners through the metacognitive scaffolds built into CBLEs. Since the question of the relative efficacy of human versus computer scaffolding is not a main concern of this research, a comparison to human tutors is rarely made.

Across the developmental span of interest, researchers have focused on two core issues: (1) the relationship of metacognition to learning complex topics in computer-based learning environments; and (2) the design of effective scaffolds embedded in computer-based learning environments (CBLEs). Two major findings, discussed in detail later, derive from these foci; first, students with strong self-regulated learning skills (including metacognitive skills) learn more than students with weak self-regulated learning skills when studying in complex CBLEs and second, adaptive scaffolds are more effective than fixed scaffolds in enabling student learning in CBLEs. The research discussed below suggests that computer-based, fixed scaffolds may be most effective when utilized in conjunction with both human and computer-based, adaptive scaffolds such as virtual agents. We now discuss each research focus in turn.

Metacognition and Learning Complex Topics in CBLEs

Past research has indicated that students have real difficulties learning complex topics in CBLEs (Shapiro & Niederhauser, 2004). This finding holds true for younger students as well as undergraduates (Azevedo, Moos, Greene, Winters, & Cromley, 2008; Azevedo, Guthrie, & Seibert, 2004). CBLEs have multiple representations of content including text, diagrams, audio, images, animations and video material (Jacobson & Azevedo, 2008). One navigates a CBLE via hyperlinks; students are able to select their own path through the material. It is argued that this nonlinear presentation of the material in a CBLE places special demands on learners, for example, it may result in cognitive overload (Greene, Moos, Azevedo & Winters, 2008) and/or disorientation (Greene, Bolick, & Robertson, 2010; Puntambekar & Stylianou, 2005).

Azevedo, Cromley, and Seibert (2004) argued that the nonlinearity of CBLEs also places special metacognitive demands on learners. Indeed, students entering a CBLE must make metacognitive control decisions about which material to engage with first and which links are the most relevant to their specific line of inquiry. However, not many students have strong metacognitive monitoring and control abilities, two concepts that are at the heart of self-regulated learning theory (Hadwin & Winne, 2001). Therefore, one method for helping students improve their ability to learn from computer-based learning systems is to improve their metacognitive self-regulation skills (Azevedo & Cromley, 2004).

Toward that end, Azevedo and his colleagues launched an ambitious research agenda focused on understanding students' use of self-regulated learning (SRL) skills while studying in a CBLE. A stated goal of this research was to develop CBLE design guidelines specific to metacognitive scaffolding. While this research has been framed as investigations of students' SRL skills, the majority of the SRL skills assessed in this research are metacognitive in nature. The research studies conducted by Azevedo and his colleagues have occurred at the middle school (Azevedo et al., 2008; Greene et al., 2008), high school (Azevedo, Cromley, Winters, Moos, & Greene, 2005; Greene, Bolick, & Robertson, 2010) and college level (Azevedo & Cromley, 2004; Azevedo, Cromley, & Seibert, 2004; Azevedo, Guthrie, & Seibert, 2004) and they have focused on the learning of complex systems in science and history.

The initial study in this series was conducted by Azevedo, Guthrie, and Seibert (2004) as they sought to understand if there were differences in students' use of SRL skills while studying about a complex science topic in a CBLE: the human circulatory system; and if so, did this result in differences in students' development of a mental model of the circulatory system. During this initial study, the researchers developed their methodology for examining students' SRL skills, which they then used in numerous follow-up studies. This method included: pre- and posttests of declarative knowledge (matching, labeling, and drawing); pre- and postverbal examples of students' mental models of the circulatory system; and the gathering of think-aloud data from the students as they studied in the CBLE. The think-aloud data serve as a baseline measure of students' metacognitive capabilities inasmuch as they received no training in metacognition prior to the task and nothing in the CBLE was designed specifically to scaffold metacognition. The researchers constructed a robust rubric (discussed earlier in the chapter) that allowed them to analyze the relationship of students' SRL skill usage (including planning, monitoring, strategies, task difficulty and demands and interest) to their achievement as measured by declarative knowledge and mental model development about the circulatory system. The results of this initial study indicated that students did use different SRL skills while studying in a CBLE and that those who used more effective strategies and spent more time monitoring their learning demonstrated the greatest shift in terms of the completeness of their mental models of the circulatory system.

Based on the results of this study, Azevedo and Cromley (2004) investigated the effects of SRL training for students on their learning in a CBLE. In this study, students in the treatment condition received a 30-minute training session on SRL skills prior to studying in the CBLE. Students in the control condition received no training. Those who received the training performed significantly better on most tests of declarative knowledge and mental model development after studying with the system. This was due to their superior use of effective SRL substrategies in the areas of planning, monitoring, and strategy enactment learned as a result of the training. Azevedo and Cromley suggest that computer-based learning systems that embed aspects of the SRL training may improve student learning of complex topics in CBLEs. Such embedded aspects include pretests to activate prior knowledge, access to planning tools that would allow students to plan their learning in relation to an expert-set of learning goals for the content, monitoring scaffolds that provide lists that students can compare against their own learning, and prompts that get students thinking about their feeling of knowing (prior knowledge) and judgment of learning ("Am I learning anything here?") as they are working in the environment.

Human Adaptive Scaffolds Versus Fixed Scaffolds

To further investigate the design of scaffolds for learning a complex topic in a CBLE, Azevedo, Cromley, and Seibert (2004) and Azevedo et al. (2005) investigated three levels of SRL scaffolding for learning in CBLEs: no scaffold, fixed scaffold, and adaptive scaffold. The first study was conducted with undergraduates, the second with high school students. In each study, the fixed scaffold condition consisted of provision of an overall learning goal for students and a list of ten questions to guide their inquiry as they studied the human circulatory system. The adaptive scaffold consisted of a human tutor who provided assistance to the student participants related to the use of SRL strategies in completing the task, but who did not give advice on the actual content of the CBLE. This assistance included help on planning and monitoring learning as well as using different strategies and handling difficult task demands. A third group of students in each study received no scaffolding. In both studies, tests of students' understanding of the circulatory system revealed that participants in the adaptive scaffold condition learned the most. In the second study, students in the no-scaffolding condition outperformed students in the fixed scaffolding condition on tests of declarative knowledge and in mental model shift. The results of these two studies appear to indicate that certain types of fixed scaffolds (e.g., a provided list of prompts) in CBLEs may have little to no value for student learning. However, there are many types of computer-based, fixed scaffolds, some of which are more effective than others.

Computer-Based Fixed Scaffolds

Many studies have examined the use of fixed scaffolds in CBLEs and the research results on the effectiveness of these scaffolds are mixed. Research findings across the developmental span from middle school to undergraduate education do suggest that fixed scaffolds, which complement adaptive scaffolds (either human or computer-based adaptive scaffolds) are more effective than fixed scaffolds on their own.

Most CBLE fixed scaffolds consist of what Lin, Hmelo, Kinzer, and Secules (1999) described as: (a) process models (modeling metacognitive thinking processes that are usually tacit and unconscious); (b) process displays (displaying problem-solving and thought processes specific to the domain of study); and/or (c) process prompts (textual prompts that direct students' attention to specific aspects of strategies while learning is in action). CBLEs may utilize a combination of process models, process displays, and process prompts.

Process models are generally instantiated as graphical displays (Manlove, Lazonder, & de Jong, 2007; White & Frederiksen, 2005), which utilize arrows to dynamically model the process students are undertaking; whereas, process displays have been operationalized as digital notebooks (Brush & Saye, 2001; Quintana, Zhang, & Kracjik, 2005; White & Frederiksen, 1998). Such notebooks provide students with a high-level, organizational overview of the activity in which they are about to take part. White and Frederiksen's science-based CBLE, Inquiry Island, utilizes both process model (graphical displays) and process display (digital notebook) scaffolds. In addition to these computer-based, fixed scaffolds, the Inquiry Island curriculum intervention also included computer-based and human-based adaptive scaffolds. The computer-based adaptive scaffolds consisted of a multiagent system of advisors that could assist students in developing their metacognitive understanding. The human-based adaptive scaffolds consisted of students' working in groups and taking on the roles of the metacognitive advisors found in the software itself, such as the role of reflector, as well as some teacher scaffolding of student reflection through question prompts. In a controlled experiment of the Inquiry Island curriculum, White and Frederiksen (2005) found that their metacognitive intervention was an effective means of increasing student achievement in science. However, this study's outcome measures focused on student learning of the process of inquiry and there was not an attempt to disentangle the relative contribution of each element of the designed environment/curriculum to this learning. Therefore, there is no independent confirmation that either the computer-based process model or process display fixed scaffolds were useful or to what degree they were useful.

In research on process displays embedded in Decision Point!, a CBLE about the Civil Rights Movement in the United States, Brush and Saye (2001) created a guided notebook to scaffold student understanding of the methods historians use to analyze historical events. The guided notebook consisted of data analysis categories that a historian might use to examine the event; the student could add information to these categories as they conducted their research. This method was applied to historical interactive essays made available in Decision Point!. In a qualitative study of student use of the system, Brush and Saye found that the guided notebook was largely ineffective because the students tended to record superficial information under the data analysis categories provided and they only took notes for about 50% of the interactive essays viewed.

Inquiry Island, Decision Point!, and other CBLEs have also used process prompts to urge students to either reflect on their own learning (usually in some form of journal) or to ponder questions or advice posed by the CBLE itself. For example, Brush and Saye (2001) used reflective prompts in Decision Point! to urge students to reflect on what they had learned in their history inquiries and/or to list the questions and concerns that had come up for them while working in the history CBLE. Brush and Saye found that the prompts to reflect in the journal, and the journal itself, similar to the guided notebook, were not effective interventions, in that many students either did not bother to use the journal, or only added superficial reflections. Importantly, Brush and Saye made a distinction between the metacognitive scaffolds embedded in the system (the guided notebook and the journal, which were largely ineffective) and conceptual scaffolds that were also embedded in the CBLE. The conceptual scaffolds included the interactive essay itself as well as a drop down menu list that highlighted important documents to be viewed related to the historical event under study. Brush and Saye reported that the conceptual scaffolds were more effective in supporting student learning in that students used them more often and reported finding them to be useful in their study of the Civil Rights movement.

While Brush and Saye (2001) reported mixed results in their research on fixed scaffolds in CBLEs, Manlove, Lazonder, and de Jong (2007) found that the fixed scaffolds (process model and process prompts—titled the Process Coordinator) provided in their physics-based CBLE inhibited student learning. While the treatment group's final lab report had a better structure than the control group (which the researchers attributed to the metacognitive prompts) the students in the control condition outperformed students in the treatment condition in regard to the development of a runnable mental model of a fluid dynamics problem (the task required students to discover the physics-based factors that would influence the amount of time it would take for water to empty out of a tank through a drain hole). The authors provided two possible explanations for the negative result: first, the time it took for students in the treatment condition to work with the support functions may have impeded their mental model development, and/or second, students in the control condition utilized help files embedded in the system that may have had a direct benefit on mental model understanding. A third possibility not mentioned by the authors is that fixed scaffolds are perhaps most effective when complementing adaptive scaffolds.

For example, White and Frederiksen (1998) used fixed, textual prompts in their Thinker Tools CBLE to scaffold student thinking about science inquiry. However, students also had access to human scaffolding of their reflections. The students engaged in both private, computer-based self-assessment, and public, whole class assessment of peers' work. Peer assessment occurred at the end of each inquiry project when groups presented their work to the class. At this time, students provided both verbal and written feedback to their peers. Perhaps due to the fact that there was an added social and public element to the reflection process in the Thinker Tools curriculum, the outcomes for science inquiry learning were strong. In other words, reflective assessment in the Thinker Tools curriculum was an effective activity because the assessments included self and peer aspects, human and computer-based scaffolds, private and public elements, and the assessments were given both verbally and in writing; unlike the reflection journal in Decision Point!, which stood alone as a fixed scaffold that prompted private, self-reflection in writing only.

Success in learning with only fixed scaffolds was reported by Kim and Pedersen (2010). These researchers utilized structural equation modeling to examine their theory that both prior domain knowledge and metacognitive knowledge affects hypothesis development in science inquiry activities. In their study, they used self-questioning prompts to urge students to reflect on their learning process in the Animal Investigations CBLE. Kim and

Pedersen reported a good model fit of the data to their theory on the relevance of prior knowledge and metacognition to effective hypothesis development. Therefore, the fixed scaffolds in this study, in the form of self-questions, appear to have been helpful to students in terms of the development of metacognitive knowledge.

Aleven and Koedinger (2002) also reported on the efficacy of fixed scaffolds. These researchers looked at student learning with a geometry tutor computer program. Students in the treatment condition received prompts to select an explanation of the problem they just solved from a drop-down menu. These students did significantly better on certain types of problems (reason and not-enough-information problems) than did students who were in a problem solving only condition. Also, students in the treatment condition developed greater levels of declarative knowledge (integrating visual and verbal aspects) while students in the control condition developed greater procedural knowledge.

Computer-Based Adaptive Scaffolds

In addition to the textual process prompts provided in the CBLEs discussed thus far, process prompts have also been provided by means of virtual agents. White and Frederiksen's (2005) Inquiry Island CBLE is a multi-agent system that features several programmable advisors (Quentin the Questioner, Molly the Monitor, Pablo the Planner, and others) that provide metacognitive advice. For example, Quentin the Questioner provides advice on strategies to use when developing a research question such as, "Be uncertain about the answer: Does your question have an obvious answer? If so, why bother investigating it? Keep thinking until you come up with a question for which you aren't sure about the answer" (White & Frederiksen, p. 213). These advisors are programmable. Students can add advice to an advisor and this advice becomes a part of the advisors' repertoire; it can be given to students at a later time. In this way, the agent prompt scaffold in Inquiry Island becomes an adaptive scaffold. Due to this programmable aspect, the advisors can change in response to learner needs and abilities. They are adaptable to the needs of the students, and adapted by the students themselves—making this adaptive scaffold both computer- and human-based. In a study of the effectiveness of this curriculum in a fifth-grade classroom, the researchers found that students who were in the metacognitive advisor condition significantly improved their metacognitive abilities and their ability to do inquiry as compared to students who did the same inquiry project but did not use the Inquiry Island CBLE and, therefore, had no access to the adaptive scaffolds of the programmable, metacognitive advisors.

Molenaar, van Boxtel, and Sleegers (2010) also conducted a study that utilized a virtual agent to prompt students' metacognitive activity. Their study focused on how to increase the co-regulation of a group when learning in a CBLE in order to improve learning outcomes. The CBLE featured a three-dimensional virtual agent embedded in the learning environment. The researchers examined two types of scaffolds: structured or problematized. In the structured environment, the agent provides a worked example of how to create a mind map. In the problematized scaffold, the CBLE prompts the students to think about how to do the task by asking "How can you plan a mind map assignment?" These problematized scaffolds are meant to trigger metacognitive activity on the part of the students. The students in the study worked in an online environment to answer the question of whether they would like to live abroad in either New Zealand or Iceland. The scaffolds were timed to be delivered by the agent in relation to learner activity (orientation, planning, monitoring). The user could send information back to the agent in terms of a question mark, a happy, sad or neutral face. These two latter elements create an adaptive element to the scaffold. The researchers found that students in the problematized scaffold condition showed higher levels of metacognition and performed better on a near-transfer task. There were no other significant differences among the two conditions.

Biswas, Leelawong, Schwartz, Vye, and the Teachable Agents Group at Vanderbilt (2005) utilized the concept of a teachable agent to help students develop metacognitive understanding. In their study, students provided Betty, the teachable agent, with knowledge by creating a concept map about a river ecosystem. The developers provided Betty with metacognitive capabilities including the ability to monitor, assess, set goals, seek assistance, and reflect on feedback. Betty used these abilities to examine the chain of reasoning that was being built by the students as they developed the concept map and to remark to the students when the chain of reasoning did not make sense. The researchers found that in a controlled study, students in the metacognition condition demonstrated a better ability to learn new material and to complete a far transfer task.

Puntambekar and Stylianou (2005) also produced an adaptive scaffold computer environment. Their research focused on navigational issues that middle school students can run into while working in a web-based learning management system (LMS). The researchers conducted two studies. In the first study, they examined students' navigational patterns as they traversed the LMS. From an analysis of this data, the researchers developed specific scaffolds to help other students more easily navigate the environment. These specific scaffolds were then provided to students in a second study as they navigated through the LMS. These scaffolds proved to be effective in impacting student learning in CBLEs. However, the time- and labor-intensive nature of this type of supportive scaffolding will only work on a large scale once the entire process of data collection and analysis of navigation patterns has been computerized. Also, more research is needed to understand whether such navigational help will reliably result in better learning outcomes for students.

Aleven and his colleagues have been working on developing adaptive scaffolds that are built on a help-seeking model. This help-seeking model works with a cognitive model in a cognitive tutor to provide metacognitive help at the moment it is needed (Aleven, McLaren, Roll, & Koedinger, 2006; Roll, Baker, Aleven, McLaren, & Koedinger, 2005). In this scenario, the help-seeking model attempts to understand "how" students go about seeking help in a CBLE and it works in conjunction with the cognitive model, which attempts to understand the students' current cognitive comprehension of the problem at hand.

The help-seeking model has been developed based on two constructs: (1) the ideal help-seeking model (as derived from the work of Nelson-Le Gall, 1981; Newman, 1994), and (2) "gaming the system" behavior (Roll et al., 2005). The help-seeking model allows the tutor to monitor student activity in the system and present error messages when maladaptive metacognitive activity is sensed. Based on their empirical work with students using their tutors, the researchers have grouped maladaptive metacognitive behavior into four categories: (1) help abuse; (2) try-step abuse; (3) help avoidance; and (4) general bugs. Several subitems are listed in each category. For example in the help-abuse category, the researchers list: asking for a hint when should try, clicking through hints, ask for hint when should search for information, and information resource overuse. The gaming the system detector tracks whether or not the student is attempting to exploit regularities in the system, for example, clicking quickly through all hints to get to the "bottom out" hint, which essentially provides a worked example of the problem to the students. This second type of maladaptive metacognitive behavior is interesting in that students have to understand enough about the system in order to exploit it. This monitoring of a student's help-seeking behavior provides the computer tutor system with information with which it can adaptively guide the student to actions that are more metacognitively sound, including self-questioning (What do I know? What do I need to know? How can I gain that information?).

Aleven et al. (2006) examined how well the help-seeking model predicted post-test scores on geometry assessments, based on the number of metacognitive errors committed by students. They found that the model did predict post-test scores. However, they also learned that the help-seeking tutor was offering too much advice to the students. As programmed, the help-seeking tutor provided feedback to students on 73% of their actions within the system. The researchers argued that this frequency of feedback may not be useful to students. Roll, Aleven, McLaren, Ryu, Baker, and Koedinger (2006) found that while the help-seeking tutor was successful in giving feedback on correcting metacognitive errors it did not lead to improved learning in the domain or to higher levels of declarative knowledge.

Due to these mixed findings about the effectiveness of the help-seeking tutor, Roll, Aleven, McLaren and Koedinger (2007) undertook research to examine whether or not the help-seeking tutor could lead to greater domain knowledge, better help-seeking behavior or higher levels of declarative help-seeking knowledge. They did this by creating two new elements for the help tutor—an update to the tutor that not only pointed out metacognitive errors to the students, with recommendations for what to do next, but also stressed the benefits of figuring out what one's metacognitive errors are toward the goal of eliminating them. They also included classroom instruction related to help-seeking, which consisted of explicit, declarative instruction about how to use the tutor effectively. For example, the teacher in the classroom reminded students "You will not learn by guessing or abusing hints, even if you get the answer right" (Roll et al., 2007, p. 206). The results of this study showed that the declarative instruction on help-seeking, the self-assessment and the help tutor did not result in higher levels of domain knowledge or higher levels of help-seeking behavior. However, students who were in the help tutor condition did develop significantly higher levels of declarative knowledge related to help-seeking.

Roll et al. (2007) provided several possible explanations for these results. One idea is that elaborated hints are not helpful when self-explanation is required. Another is that the researchers' understanding of maladaptive help-seeking behavior may be inaccurate given that students who seek the bottom-out hint (initially considered a maladaptive metacognitive behavior) actually learn as much as those who do not. So the idea of progressive hints may be faulty—it may be better for students to learn from solved or worked out examples. Finally, the authors conjecture that the unfamiliarity of the tutor environment may lead to lower levels of student motivation to use the hint system, or that the benefit of not looking at hints is greater from a time perspective and a short-term small gains approach than a long-term benefits approach. Another important idea to consider is how effective fixed and adaptive scaffolds may work together to improve student learning. For example, in a math-based classroom that is utilizing the algebra and/or geometry tutor, considering how either a programmable multi-agent system, or a public, peer-based, reflective assessment class activity may improve learning seems worthwhile; particularly due to the fact that these methods have proven quite powerful in the domain of science inquiry (White & Frederiksen, 1998, 2005).

In conclusion, research on metacognition and computers has focused on investigating the connection between metacognition and the learning of complex topics in CBLEs, as well as investigating methods and means of scaffolding metacognitive understanding in CBLEs. The first research focus clearly established that adaptive scaffolds provided by human tutors in are superior to computer-based fixed scaffolds. However, computer-based, fixed scaffolds are effective in some instances, for example when prompting self-questioning. More specifically, computer-based fixed scaffolds may be an effective complement to a holistic system of metacognitive learning that includes both human- and computer-based adaptive scaffolds. Furthermore, researchers have established innovative methods for creating computer-based adaptive scaffolds including allowing students to program metacognitive agents, providing customized scaffolds based on learners' website navigation patterns and through the development of computer-based tutor systems that work together to address student needs. Although promising, this research has shown that we still know little about how to create the adaptive scaffolds that will be useful to students in every setting. It is unlikely that the type of adaptive scaffolding that can be provided by a human tutor will be provided by a CBLE anytime soon. However, future research that examines more closely the metacognitive scaffolding provided by effective teachers would seem to hold much promise for designing and developing adaptive scaffolds that respond to student needs in real-time. Furthermore, future research should also focus on creating a deeper understanding of the emergent and strategic methods that students develop, which exceed the intention of the designs we provide them.

CONCLUSION: FUTURE RESEARCH ON METACOGNITION

We are encouraged by the promising future of metacognitive research, as researchers working from various disciplines begin to integrate theoretical frameworks and research methodologies, perhaps creating emergent models incorporating the varied theoretical perspectives. For example, cognitive scientists, neuropsychologists and clinicians, who have traditionally focused on deficits in executive function, are beginning to use their brain-based methods to examine executive function in normal populations. Cognitive psychologists, who have traditionally employed calibration techniques to study metacognition in controlled learning situations, are beginning to seek more applications of their work to classroom contexts and to use mixed method designs augmenting quantitative data with qualitative analyses (Carroll, 2008; Hacker, Bol, & Keener, 2008). Developmental and educational psychologists, evolving from the traditional approaches to metacognition and self-regulation, are becoming more familiar with the work of their European colleagues, particularly since the launching of an interdisciplinary, international journal focused on metacognition called *Metacognition and Learning* (published by Sage) in 2006. Researchers are explicitly pursuing connections between classroom and laboratory based research – from both sides of the research continuum and with a global perspective.

We have made tremendous progress in developing effective instructional methods to promote the development of metacognitive knowledge and skills and have identified a number of instructional methods that are effective in a variety of academic domains. Computer-based learning environments encouraging metacognitive development, with the potential to adapt flexibly and sensitively to the instructional needs of individual students, have been designed. We are learning more about how teachers can promote and support the development of metacognition in themselves and their students. Because metacognitive instruction appears to be linked to effective learning and subsequent academic achievement, these educational interventions have the potential to reduce long identified achievement gaps. We envision a future where effective interventions for the development of academic skills in students are widely used in elementary and secondary school classrooms, incorporated into summer transition programs and into first-year experiences, with the end result of ensuring a successful transition to college and enhancing college retention. The ultimate result of this work is significant, ultimately realizing the promise of access and equity and allowing more students to pursue their dreams and achieve their potential.

REFERENCES

Afflerbach, P., & Meuwissen, K. (2005). Teaching and learning self-assessment strategies in middle school. In S. Israel, C. Block, & K. Kinnucan-Welsch (Eds.), *Metacognition in literacy learning: Theory, assessment, instruction, and professional development* (pp. 141–164). Hillsdale, NJ: Erlbaum.

Aleven, V. A., & Koedinger, K. R. (2002). An effective metacognitive strategy: Learning by doing and explaining with a computer-based cognitive tutor. *Cognitive Science, 26,* 147–179.

Aleven, V., McLaren, B., Roll, I., & Koedinger, K. (2006). Towards meta-cognitive tutoring: a model of help seeking with a cognitive tutor. *International Journal of Artificial Intelligence in Education, 16,* 101–128.

Azevedo, R., & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students' learning with hypermedia? *Journal of Educational Psychology, 96*(3), 523–535.

Azevedo, R., Cromley, J. G., & Siebert, D. (2004). Does adaptive scaffolding facilitate students' ability to regulate their learning with hypermedia? *Contemporary Educational Psychology, 29,* 344–370.

Azevedo, R., Cromley, J. G., Winters, F. I., Moos, D. C., & Greene, J. A. (2005). Adaptive human scaffolding facilitates adolescents' self-regulated learning with hypermedia. *Instructional Science, 33,* 381–412.

Azevedo, R., Guthrie, J. T., & Seibert, D. (2004). The role of self-regulated learning in fostering students' conceptual understanding of complex systems with hypermedia. *Journal of Educational Computing Research, 30*(1), 87–111.

Azevedo, R., Moos, D. C., Greene, J. A., Winters, F. I., Cromley, J. G. (2008). Why is externally-facilitated regulated learning more effective than self-regulated learning with hypermedia? *Educational Technology Research & Development, 56,* 45–72.

Baker, L. (2002). Metacognition in comprehension instruction. In C. Block & M. Pressley (Eds.), *Comprehension instruction: Research-based best practices* (pp. 77–95). New York, NY: Guilford Press.

Baker, L. (2008). Metacognition in comprehension instruction: What we've learned since NRP. In C. C. Block & S. R. Parris (Eds.), *Comprehension instruction: Research-based best practices* (2nd ed., pp. 65–79). New York, NY: Guilford Press.

Baker, L., & Beall, L. C. (2009). Metacognitive processes and reading comprehension. In S. E. Israel & G. G. Duffy (Eds.), *Handbook of research on reading comprehension* (pp. 373–388). New York, NY: Routledge.

Baumann, J. F., Seifert-Kessell, N., & Jones, L. A. (1992). Effect of think-aloud instruction on elementary students' comprehension monitoring abilities. *Journal of Reading Behavior, 24,* 143–172.

Beck, I. L., & McKeown, M. G. (2006). *Improving comprehension with questioning the author*. New York, NY: Scholastic.

Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, NJ: Erlbaum.

Berliner, D. C. (2004). Describing the behavior and documenting the accomplishments of expert teachers. *Bulletin of Science, Technology & Society, 24*(3), 200–212.

Biggs, J. B. (1987). *Student approaches to learning and studying*, Melbourne, Australia: Australian Council for Educational Research.

Biswas, G., Leelawong, K., Schwartz, D., Vye, N. & the Teachable Agents Group at Vanderbilt (2005). Learning by teaching: A new agent paradigm for educational software. *Applied Artificial Intelligence, 19,* 363–392.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bransford, J., Sherwood, R., Vye, N., & Rieser, J. (1986). Teaching thinking and problem solving: Research foundations. *American Psychologist, 41,* 1078–1089.

Brown, A. L. (1997). Transforming schools into communities of thinking and learning about serious matters. *American Psychologist, 52*(4), 399–413.

Brown, A., Armbruster, B. B., & Baker, L. (1986). The role of metacognition in reading and studying. In J. Orasanu (Ed.), *Reading comprehension: From research to practice* (pp. 49–75). Hillsdale, NJ: Erlbaum.

Brown, A. L., & Palincsar, A. S. (1989). Guided cooperative learning and individual knowledge acquisition. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 393–451). Hillsdale, NJ: Erlbaum.

Brown, R., Pressley, M., Van Meter, P., & Schuder, T. (1996). A quasi-experimental validation of transactional strategies instruction with low-achieving second-grade readers. *Journal of Educational Psychology, 88*(1), 18–37.

Brush, T., & Saye, J. (2001). The use of embedded scaffolds with hypermedia-supported student-centered learning. *Journal of Educational Multimedia and Hypermedia, 10*(4), 333–356.

Carr, M. (2010). The importance of metacognition for conceptual change and strategy use in mathematics. In H. S. Waters & W. Schneider (Eds.), *Metacognition, strategy use, and instruction* (pp. 177–197). New York, NY: Guilford Press.

Carroll, M. (2008). Metacognition in the classroom. In J. Donlosky & R. A. Bjork (Eds.), *Handbook of metamemory and memory* (pp. 411–427). New York, NY: Taylor & Francis.

Casteel, C. P., Isom, B. A. & Jordan, K. F. (2000). Creating confident and competent readers: Transactional strategies instruction. *Intervention in School and Clinic, 36*(2), 67–74.

Chiang, E. S., Therriault, D. J., & Franks, B. A. (2010). Individual differences in relative metacomprehension accuracy: Variation within and across task manipulations. *Metacognition and Learning, 5*(2), 121–135.

Cornoldi, C. (1998). The impact of metacognitive reflection on cognitive control. In G. Mazzoni & T. O. Nelson (Eds.), *Metacognition and cognitive neuropsychology: Monitoring and control processes* (pp. 139–159). Mahwah, NJ: Erlbaum.

Davidson, J. E., Deuser, R., & Sternberg, R. J. (1994). The role of metacognition in problem solving. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 207–226). Cambridge, MA: MIT Press.

Davidson, J. E., & Sternberg, R. J. (1998). Smart problem solving: How metacognition helps. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 47–68). Mahwah, NJ: Erlbaum.

Dawson, P., & Guare, R. (2010). *Executive skills in children and adolescents: A practical guide to assessment and intervention.* New York, NY: Guilford Press.

Delclos, V. R., & Harrington, C. (1991). Effects of strategy monitoring and proactive instruction on children's problem-solving performance. *Journal of Educational Psychology, 83,* 35–42.

Desoete, A. (2009). The enigma of mathematical learning disabilities: Metacognition or STICORDI, that's the question. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 206–218). New York, NY: Routledge.

Desoete, A., & Roeyers, H. (2006). Metacognitive macroevaluations in mathematical problem solving. *Learning and Instruction, 16,* 2–25.

Dimmitt, C., & McCormick, C. B. (in press). Metacognition in education. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Application to learning and teaching*. Washington, DC: American Psychological Association.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review, 20,* 391–409.

Duffy, G. G. (2002). The case for direct explanation of strategies. In C. C. Block & M. Pressley (Eds.), *Comprehension instruction* (pp. 28–41). New York, NY: Guilford Press.

Duffy, G. G., Miller, S., Parson, S. & Meloth, M. (2009). Teachers as metacognitive professionals. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 240–256). New York, NY: Routledge.

Duffy, G. G., & Roehler, L. R. (1989). Why strategy instruction is so difficult and what we need to do about it. In C. B. McCormick, G. Miller, & M. Pressley (Eds.), *Cognitive strategy research: From basic research to educational applications* (pp. 133–154). New York, NY: Springer-Verlag.

Duffy, G. G., Roehler, L. R., Meloth, M. S., Vavrus, L. G., Book, C., Putnam, J., & Wesselman, R. (1986). The relationship between explicit verbal explanations during reading skill instruction and student awareness and achievement: A study of reading teacher effects. *Reading Research Quarterly, 21*(3), 237–252.

Duffy, G. G., Roehler, L., Sivan, E., Rackliffe, G., Book, C., Meloth, M. S., . . . Bassiri, D. (1987). Effects of explaining the reasoning associated with using reading strategies. *Reading Research Quarterly, 22,* 347–368.

Duncan, T. G., & McKeachie, W. J. (2005). The making of the motivated strategies for learning questionnaire. *Educational Psychologist, 40*(2), 117–128.

Dunlosky, J., & Lipko, A. R. (2007). Metacomprehension: A brief history and how to improve its accuracy. *Current Directions in Psychological Science, 16*(4), 228–232.

Dunlosky, J., & Metcalfe, M. (2009). *Metacognition*. Thousand Oaks, CA: Sage.

Dunlosky, J., Rawson, K. A., & Middleton, E. L. (2005). What constrains the accuracy of metacomprehension judgments? Testing the transfer-appropriate monitoring and accessibility hypotheses. *Journal of Memory and Language, 52,* 551–565.

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist, 46*(1), 6–25.

Entwistle, N., & McCune, V. (2004). The conceptual bases of study and strategy inventories. *Educational Psychology Review, 16*(4), 325–345.

Everson, H. T., & Tobias, S. (2001). The ability to estimate knowledge and performance in college: A metacognitive analysis. In H. Hartman, (Ed.), *Metacognition in learning and instruction: Theory, research and practice* (pp. 69–83). Norwell, MA: Kluwer.

Fischer, K. W., & Daley, S. G. (2007). Connecting cognitive science and neuroscience to education: Potentials and pitfalls in inferring executive processes. In L. Meltzer (Ed.) *Executive function in education: From theory to practice* (pp. 55–72). New York, NY: Guilford Press.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The nature of intelligence* (pp. 231–235). Hillsdale, NJ: Erlbaum.

Flavell, J. H. (1985). *Cognitive development*. Englewood Cliffs, NJ: Prentice-Hall.

Flower, L. (1994). Metacognition: A strategic response to thinking. In L. Flower, *The construction of negotiated meaning* (pp. 223–262). Carbondale: Southern Illinois University Press.

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication, 32,* 365–387.

Fox, E., & Riconscente, M. (2008). Metacognition and self-regulation in James, Piaget, and Vygotsky. *Educational Psychology Review, 20,* 373–389.

Fusco, E., & Fountain, G. (1992). Reflective teacher, reflective learner. In A. L. Costa, J. Bellanca, & R. Fogarty (Eds.), *If minds matter: A foreward to the future* (Vol. 1, pp. 239–255). Palatine, IL: Skylight.

Fuson, K. C., Kalchman, M., & Bransford, J. D. (2005). Mathematical understanding: An introduction. In M. S. Donovan & J. D. Bransford (Eds.). *How students learn: History, mathematics, and science in the classroom* (pp. 217–256). Washington, DC: The National Academies Press.

Gajria, M., Jitendra, A. K., Sood, S., & Sacks, G. (2007). Improving comprehension of expository text in students with LD: A research synthesis. *Journal of Learning Disabilities, 40*(3), 210–225.

Garner, J. K. (2009). Conceptualizing the relations between executive functions and self-regulated learning. *Journal of Psychology, 143*(4), 405–426.

Garner, R. (1987). *Metacognition and reading comprehension*. Norwood, NJ: Ablex.

Garner, R., & Alexander, P. A. (1989). Metacognition: Answered and unanswered questions. *Educational Psychologist, 24,* 143–158.

Glava, C. -C., & Glava, A. -E. (2011). Development of metacognitive behavior of future teacher students through electronic learning diaries as means of self-reflection. *Procedia Computer Science, 3,* 649–653.

Glenberg, A. M., & Epstein, W. (1985). Calibration of comprehension. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 11,* 702–718.

Graham, S. (2006). Writing. In P. Alexander & P. Winner (Eds.), *Handbook of educational psychology* (pp. 457–478). Mahwah, NJ: Erlbaum.

Graham, S., & Harris, K. R. (2003). Students with learning disabilities and the process of writing: A meta-analysis of SRSD studies. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 323–344). New York, NY: Guilford Press.

Graham, S., & Perin, D. (2007). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology, 99,* 445–476.

Greene, J. A., Moos, D. C., Azevedo, R., & Winters, F. I. (2008). Exploring differences between gifted and grade-level students' use of self-regulatory learning processes with hypermedia. *Computers & Education, 50,* 1069–1083.

Greene, J. A., Bolick, C. M., & Robertson, J. (2010). Fostering historical knowledge and thinking skills using hypermedia learning environments: The role of self-regulated learning. *Computers & Education, 54,* 230–243.

Griffin, T. D., Wiley, J., & Thiede, K. W. (2008). Individual differences, rereading, and self-explanation: Concurrent processing and cue validity as constraints on metacomprehension accuracy. *Memory and Cognition, 36,* 93–103.

Hacker, D. J., Bol, L., & Bahbahani, K. I. (2008). Explaining calibration accuracy in classroom contexts: The effects of incentives, reflection, and explanatory style. *Metacognition and Learning, 3*(2), 101–121.

Hacker, D. J., Bol, L., Horgan, D. D., & Rakow, E. A. (2000). Test prediction and performance in a classroom context. *Journal of Educational Psychology, 92,* 160–170.

Hacker, D. J., Bol, L., & Keener, M. C. (2008). Metacognition in education: A focus on calibration. In J. Donlosky & R. A. Bjork (Eds.), *Handbook of metamemory and memory* (pp. 429–455). New York, NY: Taylor & Francis.

Hacker, D. J., Keener, M. C., & Kircher, J. C. (2009). Writing is applied metacognition. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 154–172). New York, NY: Routledge.

Hadwin, A. F., & Winne, P. H. (2001). CoNoteS2: A software tool for promoting self-regulation. *Educational Research and Evaluation, 7,* 313–334.

Haines, D. J., & Torgeson, J. K. (1979). The effects of incentives on rehearsal and short-term memory in children with reading problems. *Learning Disabilities Quarterly, 2,* 48–55.

Harris, K. R., & Graham, S. (1992). Self-regulated strategy development: A part of the writing process. In M. Pressley, K. R. Harris, & J. T. Guthrie (Eds.), *Promoting academic competence and literacy in school* (pp. 277–309). New York, NY: Academic Press.

Harris, K. R., Graham, S., Brindle, M., & Sandmel, K. (2009). Metacognition and children's writing. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 131–153). New York, NY: Routledge.

Harris, K. R., Santangelo, T., & Graham, S. (2010). Metacognition and strategies instruction in writing. In H. S. Waters & W. Schneider (Eds.), Metacognition, strategy use, and instruction (pp. 226–256). New York, NY; Guilford Press.

Hartman, H. J. (2001a). Developing students' metacognitive knowledge and skills. In H. J. Hartman (Ed.), *Metacognition in learning and instruction: Theory, research and practice* (pp. 33–68). Dordrecht, The Netherlands: Kluwer.

Hartman, H. J. (2001b). Teaching metacognitively. In H. J. Hartman (Ed.), *Metacognition in learning and instruction: Theory, research and practice* (pp 149–169). Dordrecht, The Netherlands: Kluwer.

Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing* (1–28). Mahwah, NJ: Erlbaum.

Hayes, J. R. (2006). New directions in writing theory. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 28–40). New York, NY: Guilford Press.

Hayes, J. R., & Flower, L. (1980). Identifying the organization of writing processes. In L. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3–30). Hillsdale, NJ: Erlbaum.

Hofer, B., Yu, S., & Pintrich, P. R. (1998). Teaching college students to be self-regulated learners. In D. H. Schunk, & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice*. (pp. 57–85). New York, NY: Guilford Press.

Isaacson, R. M., & Fujita, F. (2006). Metacognitive knowledge monitoring and self-regulated learning: Academic success and reflections on learning. *Journal of the Scholarship of Teaching and Learning, 6* (1), 39–55.

Jacobs, J. E., & Paris, S. G. (1987). Children's metacognition about reading: Issues in definition, measurement, and instruction. *Educational Psychologist, 22,* 255–278.

Jacobson, M. J., & Azevedo, R. (2008). Advances in scaffolding learning with hypertext and hypermedia: theoretical, empirical, and design issues. *Educational Technology Research & Development, 56* (1), 1–3.

Justice, E. M., & Dornan, T. M. (2001). Metacognitive differences between traditional-age and nontraditional-age college students. *Adult Education Quarterly, 51* (3), 236–249.

Kamil, M. L., Mosenthal, P. B., Pearson, P. D., & Barr, R. (Eds.), (2000). *Handbook of reading research* (Vol. 3). Mahwah, NJ: Erlbaum.

Kardash, C. M., & Amlund, J. T. (1991). Self-reported learning strategies and learning from expository text. *Contemporary Educational Psychology, 16,* 117–138.

Karpicke, J. D., Butler, A. C., & Roediger, H. L. (2009). Metacognitive strategies in student learning: Do students practice retrieval when they study on their own? *Memory, 17,* 471–479.

Keleman, W. L., Frost, P. J., & Weaver, C. A. (2000). Individual differences in metacognition: Evidence against a general metacognitive ability. *Memory & Cognition, 28* (1), 92–107.

Kim, H. J., & Pedersen, S. (2010). Young adolescents' metacognition and domain knowledge as predictors of hypothesis-development performance in a computer-supported context. *Educational Psychology, 30* (5), 565–582.

King, A. (1991). Effects of training in strategic questioning on children's problem-solving performance. *Journal of Educational Psychology, 83,* 307–317.

King, A. (1997). ASK to THINK – TEL WHY®©: A model of transactive peer tutoring for scaffolding higher level complex learning. *Educational Psychologist, 32* (4), 221–235.

King, A. (1998). Transactive peer tutoring: Distributing cognition and metacognition. *Educational Psychology Rev. 10* : 57–74.

King, A. (2002). Structuring peer interaction to promote high-level cognitive processing. *Theory into Practice 41* (1): 33–39.

Klin, C. M., Guzman, A. E., & Levine, W. H. (1997). Knowing that you don't know: Metamemory and discourse processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 1378–1393.

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77,* 1121–1134.

Kuhn, D. (2000). Metacognitive development. *Current Directions in Psychological Science, 9* (5), 178–181.

Lee, J. C. -K., Zhang, Z., & Yin, H. (2010). Using multidimensional Rasch analysis to validate the Chinese version of the motivated strategies for learning questionnaire (MSLQ-CV). *European Journal of Psychology Education, 25,* 141–155.

Lei, S. A., Rhinehart, P. J., Howard, H. A., & Cho, J. K. (2010). Strategies for improving reading comprehension among college students. *Reading Improvement, 47* (1), 30–41.

Leutwyler, B. (2009). Metacognitive learning strategies: Differential development patterns in high school. *Metacognition and Learning, 4,* 111–123.

Lin, X. D., Hmelo, C., Kinzer, C. K., & Secules, T. J. (1999). Designing technology to support reflection. *Educational Technology, Research and Development, 47* (3), 43–62.

Lucangeli, D., & Cornoldi, C. (1997). Mathematics and metacognition: What is the nature of the relationship? *Mathematical Cognition, 3,* 121–139.

Maki, R. H. (1998). Test predictions over text material. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 117–144). Mahwah, NJ: Erlbaum.

Maki, R. H., & Berry, S. (1984). Metacomprehension of text material. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 663–679.

Maki, R. H., Shields, M., Wheeler, A. E., & Zacchilli, T. L. (2005). Individual differences in absolute and relative metacomprehension accuracy. *Journal of Educational Psychology, 97* (4), 723–731.

Manlove, S., Lazonder, A. W., & de Jong, T. (2007). Software scaffolds to promote regulation during scientific inquiry learning. *Metacogntion and Learning, 2,* 141–155.

Marsh, H., Martin, A. J & Xu, M. (in press). Self-concept: A synergy of theory, method and application. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Application to learning and teaching*. Washington, DC: American Psychological Association.

McCabe, J. (2011). Metacognitive awareness of learning strategies in undergraduates. *Memory and Cognition, 39* (3), 462–476.

McCormick, C. B. (2003). Metacognition and learning. In W. M. Reynolds & G. E. Miller (Eds), *Handbook of educational psychology* (pp. 79–102). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

McKeown, M. G., & Beck, I. L. (1994). Making sense of accounts of history: Why young students don't and how they might. In

G. Leinhardt, I. L. Beck, & K. Stainton (Eds.), *Teaching and learning in history* (pp. 1–26). Hillsdale, NJ: Erlbaum.

McKeown, M. G., & Beck, I. L. (2009). The role of metacognition in understanding and supporting reading comprehension. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 7–25). New York, NY: Routledge.

McNamara, D. S. (2004). SERT: Self-explanation reading training. *Discourse Processes, 38,* 1–30.

McNamara, D. S., & Magliano, J. P. (2009). Self-explanation and metacognition: The dynamics of reading. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 60–81). New York, NY: Routledge.

McNamara, D. S., O'Reilly, T., Best, R., & Ozuru, Y. (2006). Improving adolescent students' reading comprehension with iSTART. *Journal of Educational Computing Research, 34,* 147–171.

Meichenbaum, D., & Biemiller, A. (1992). In search of student expertise in the classroom: A metacognitive analysis. In M. Pressley, K. R. Harris, & J. T. Guthrie (Eds.), *Promoting academic competence and literacy in school* (pp. 3–56). San Diego, CA: Academic Press.

Meltzer, L. (2007). *Executive function in education: From theory to practice*. New York, NY: Guilford Press.

Meltzer, L., & Krishnan, K. (2007). Executive function difficulties and learning disabilities: Understandings and misunderstandings. In L. Meltzer (Ed.) *Executive function in education: From theory to practice* (pp. 77–132). New York, NY: Guilford Press.

Michalsky, T., Mevarech, Z. R., & Haibi, L. (2009). Elementary school children reading scientific texts: Effects of metacognitive instruction. *The Journal of Educational Research, 102*(5), 363–374.

Miller, G. E., Giovenco, A., & Rentiers, K. A. (1987). Fostering comprehension monitoring in below average readers through self-instruction training. *Journal of Reading Behavior, 14,* 379–393.

Miller, T. M., & Geraci, L. (2011, January 24). Unskilled but aware: Reinterpreting overconfidence in low-performing students. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. Advance online publication. doi: 10.1037/a0021802

Mokhtari, K., & Reichard, C. A. (2002). Assessing students' metacognitive awareness of reading skills. *Journal of Educational Psychology, 94*(2), 249–259.

Molenaar, I., van Boxtel, C. A. M., Sleegers, P. J. C. (2010). Metacognitive scaffolding in an innovative learning arrangement. *Instructional Science.* doi: 10.1007/s11251-010-9154-1

Moore, D., Zabrucky, K., & Commander, N. E. (1997). Validation of the metacomprehension scale. *Contemporary Educational Psychology, 22,* 457–471.

Morrow, L. M., Tracey, D. H., Woo, D. G., & Pressley, M. (1999). Characteristics of exemplary first-grade literacy instruction. *Reading Teacher, 52,* 462–476.

Myers, M. II., & Paris, S. G. (1978). Children's metacognitive knowledge about reading. *Journal of Educational Psychology, 70,* 680–690.

National Institute of Child Health and Human Development. (2000). *Report of the national reading panel. Teaching children to read: an evidence-based assessment of the scientific research literature on reading and its implications for reading instruction.* www.nichd.nih.gov/publications/nrp/smallbook.htm

National Reading Panel (2000). *Teaching children to read: An evidence-based assessment of the scientific literature on reading and its implications for reading instruction*. Washington, DC: National Institutes of Health. (NIH Pub. No. 00-4754)

Nelson, T. O. (1999). Cognition versus metacognition. In R. J. Sternberg (Ed.), *The nature of cognition* (pp. 625–641). Cambridge, MA: MIT Press.

Nelson, T. O., & Dunlosky, J. (1991). When people's judgements of learning (JOLs) are extremely accurate at predicting subsequent recalls: The "delayed JOL effect." *Psychological Science, 2,* 267–270.

Nelson, T. O., & Narens, L. (1990). A theoretical framework and new findings. *The Psychology of Learning and Motivation, 26,* 125–141.

Nelson, T. O., & Narens, L. (1994). Why investigate metacognition? In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 1–25). Cambridge, MA: MIT Press.

Nelson-Le Gall, S. (1981). Help-seeking: An understudied problem-solving skill in children. *Developmental Review, 1,* 224–246.

Newman, R. S. (1994). Adaptive help seeking: A strategy of self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulation of learning and performance:Issues and educational applications* (pp. 283–301). Hillsdale, NJ: Erlbaum.

O'Donnell, A. M., Dansereau, D. F., Hall, R. H., & Rocklin, T. R. (1987). Cognitive, social/affective, and metacognitive outcomes of scripted cooperative learning. *Journal of Educational Psychology, 79,* 431–437.

O'Neil, H. F., & Abedi, J. (1996). Reliability and validity of a state metacognitive inventory: Potential for alternative assessment. *Journal of Educational Research, 89*(4), 234–245.

O'Reilly, T., Best, R., & McNamara, D. S. (2004). Self-explanation reading training: Effects for low-knowledge readers. In K. Forbus, D. Gentner, & T. Regier (Eds.), *Proceedings of the 26th Annual Cognitive Science Society* (pp. 1053–1058). Mahwah, NJ: Erlbaum.

Otero, J. (2009). Question generation and anomaly detection in texts. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 47–59). New York, NY: Routledge.

Palak, D. (2011). Teacher metacognition and structure of knowledge through cognitive tools. In *Proceedings of the society for information technology and teacher education international conference, 2011* (pp. 1624–1629). Chesapeake, VA: AACE.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and monitoring activities. *Cognition and Instruction, 1,* 117–175.

Paris, S. G., Cross, D. R., & Lipson, M. Y. (1984). Informed strategies for learning: A program to improve children's reading awareness and comprehension. *Journal of Educational Psychology, 76,* 1239–1252.

Paris, S. G., & Jacobs, J. E. (1984). The benefits of informed instruction for children's reading awareness and comprehension skills. *Child Development, 55,* 2083–2093.

Paris, S. G., & Winograd, P. (1990). How metacognition can promote academic learning and instruction. In B. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 15–51). Hillsdale, NJ: Erlbaum.

Pieschl, S. (2009). Metacognitive calibration—an extended conceptualization and potential applications. *Metacognition and Learning, 4,* 3–31.

Pintrich, P. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*(4), 385–407.

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory into Practice, 41*(4), 219–225.

Pintrich, P. R., & DeGroot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82,* 33–40.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement, 53,* 801–813.

Pintrich, P. R., Wolters, C., & Baxter, G. (2000). Assessing metacognition and self-regulated learning. In G. Schraw & J. Impara (Eds.), *Issues in the measurement of metacognition* (pp. 43–97). Lincoln, NE: Buros Institute of Mental Measurements.

Pressley, M. (2000). What should comprehension instruction be the instruction of? In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, &

R. Barr (Eds.), *Handbook of reading research* (Vol. 3, pp. 545–561). Mahwah, NJ: Erlbaum.

Pressley, M. (2002a). Comprehension strategies instruction: A turn-of-the-century status report. In C. C. Block & M. Pressley (Eds.), *Comprehension instruction: Research-based best practices* (pp. 11–27). New York, NY: Guilford Press.

Pressley, M. (2002b). *Reading instruction that works: The case for balanced teaching,* 2nd edition. New York, NY: Guilford Press.

Pressley, M. (2003). Psychology of literacy and literacy instruction. In W. M. Reynolds, & G. E. Miller (Eds.), *Handbook of psychology* (Vol. 7, pp. 333–355). Hoboken, NJ: Wiley.

Pressley, M. (2005). Final reflections: Metacognition in literacy learning: Then, now, and in the future. In S. E. Israel, (Ed.), *Metacognition in literacy learning: Theory, assessment, instruction, and professional development* (pp. 391–411). Mahwah, NJ: Erlbaum.

Pressley, M. (2006). *Reading instruction that works: The case for balanced teaching*. New York, NY: Guilford Press.

Pressley, M., & Afflerbach, P. (1995). *Verbal reports of reading: The nature of constructively responsive reading*. Hillsdale, NJ: Erlbaum.

Pressley, M., & Ghatala, E. S. (1990). Self-regulated learning: Monitoring learning from text. *Educational Psychologist, 25,* 19–33.

Pressley, M., Snyder, B. L., Levin, J. R., Murray, H. G., & Ghatala, E. S. (1987). Perceived readiness for examination of performance (PREP) produced by initial reading of text and text containing adjunct questions. *Reading Research Quarterly, 22,* 219–236.

Puntambekar, S., & Stylianou, A. (2005). Designing navigation support in hypertext systems based on navigation patterns. *Instructional Science, 33*, 451–481.

Quintana, C., Zhang, M., & Kracjik, J. (2005). A framework for supporting metacognitive aspects of online inquiry through software-based scaffolding. *Educational Psychologist, 40*(4), 235–244.

Rawson, K. A., Dunlosky, J., & Thiede, K. W. (2000). The rereading effect: Metacomprehension accuracy improves across reading trials. *Memory & Cognition, 28,* 1004–1010.

Rhodes, M., & Tauber, S. K. (2011). The influence of delaying judgments of learning on metacognitive accuracy: A meta-analytic review. *Psychological Bulletin, 137*(1), 131–148.

Richardson, J. T. E. (2004). Methodological issues in questionnaire-based research on student learning in higher education. *Educational Psychology Review, 16*(4), 347–358.

Ritchhart, R., Turner, T., & Hadar, L. (2009). Uncovering students' thinking about thinking using concept maps. *Metacognition and Learning, 4,* 145–159.

Roediger, H. L. III, & Karpicke, J. D. (2005). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science, 17,* 249–255.

Roehler, L., & Duffy, G. G. (1984). Direct explanation of comprehension processes. In G. G. Duffy & J. Mason (Eds.), *Comprehension instruction: Perspectives and suggestions* (pp. 265–280). New York, NY: Longman.

Roll, I., Aleven, V., McLaren, B. M. & Koedinger, K. R. (2007). Can help seeking be tutored? searching for the secret sauce of metacognitive tutoring. *Proceedings of the 13th International Conference on Artificial Intelligence in Education,* 203–210.

Roll, I., Aleven, V., McLaren, B. M., Ryu, E., Baker, R. S., & Koedinger, K. R. (2006) The help tutor: Does metacognitive feedback improve students' help-seeking actions, skills and learning? *Proceedings of 8th International Conference in Intelligent Tutoring Systems,* 360–369. Berlin, Germany: Springer-Verlag.

Roll, I., Baker, R. S., Aleven, V., McLaren, B. M., & Koedinger, K. R. (2005) Modeling students' metacognitive errors in two intelligent tutoring systems. *Proceedings of User Modeling 2005* 379–388. Berlin, Germany: Springer-Verlag.

Rosenshine, B., & Meister, C. (1994). Reciprocal teaching: A review of the research. *Review of Educational Research, 64,* 479–530.

Scardamalia, M., & Bereiter, C. (1986). Writing. In R. F. Dillon & R. J. Sternberg (Eds.), *Cognition and instruction* (pp. 59–81). Orlando, FL: Academic Press.

Schneider, W. (2010). Metacognition and memory development in childhood and adolescence. In H. S. Waters & W. Schneider (Eds.), *Metacognition, strategy use, and instruction*. New York, NY: Guilford Press.

Schneider, W., & Pressley, M. (1997). *Memory development between two and twenty*. Mahwah, NJ: Erlbaum.

Schoenfeld, A. H. (1985). *Mathematical problem-solving*. New York, NY: Academic Press.

Schoenfeld, A. H. (1987). What's all the fuss about metacognition? In A. H. Schoenfeld (Ed.), *Cognitive science and mathematics education* (pp. 189–215). Hillsdale, NJ: Erlbaum.

Schraw, G. (2000). Assessing metacognition: Implications of the Buros symposium. In G. Schraw & J. C. Impara (Eds.), *Issues on the measurement of metacognition* (pp. 297–321). Lincoln, NE: Buros Institute of Mental Measurements.

Schraw, G. (2001). Promoting general metacognitive awareness. In H. Hartman, (Ed.), *Metacognition in learning and instruction: Theory, research and practice* (pp. 3–16). Norwell, MA: Kluwer.

Schraw, G. (2009). Measuring metacognitive judgments. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 415–429). New York, NY: Routledge.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education, 36*(1-2), 11–139.

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19,* 460–475.

Schraw, G., & Nietfeld, J. (1998). A further test of the general monitoring skill hypothesis. *Journal of Educational Psychology, 90,* 236–248.

Schwartz, B. L., & Bacon, E. (2008). Metacognitive neuroscience. In J. Donlosky & R. A. Bjork (Eds.), *Handbook of metamemory and memory* (pp. 355–371). New York, NY: Taylor & Francis.

Shapiro, A. M., & Niederhauser, D. (2004). Learning from hypertext: Research issues and findings. In D. H. Jonassen (Ed.), *Handbook of research on educational communication and technology* (2nd ed., pp. 605–620). Mahway, NJ: Erlbaum.

Sitko, B. (1998). Knowing how to write: Metacognition and writing instruction. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 93–115). Mahwah, NJ: Erlbaum.

Sperling, R. A., Howard, B. C., Miller, L. E., & Murphy, C. (2002). Measures of children's knowledge and regulation of cognition. *Contemporary Educational Psychology, 27,* 51–79.

Sperling, R. A., Howard, B. C., Staley, R., & DuBois, N. (2004). Metacognition and self-regulated constructs. *Educational Research and Evaluation, 10*(2), 117–139.

Taraban, R., Rynearson, K., & Kerr, M. (2000). College students' academic performance and self-reports of comprehension strategy use. *Reading Psychology, 21,* 283–308.

Teong, S. K. (2002). The effects of metacognitive training on mathematical word-problem solving. *Journal of computer assisted learning, 19,* 46–55.

Thiede, K. W., & Anderson, M. C. M. (2003). Summarizing can improve metacomprehension accuracy. *Contemporary Educational Psychology, 28,* 129–160.

Thiede, K. W., Anderson, M. C. M., & Therriault, D. (2003). Accuracy of metacognitive monitoring affects learning of texts. *Journal of Educational Psychology, 95,* 66–73.

Thiede, K. W., Dunlosky, J., Griffin, T., & Wiley, J. (2005). Understanding the delayed keyword effect on metacomprehension accuracy.

Journal of Experimental Psychology: Learning, Memory, and Cognition, 31, 1267–1280.

Thomas, G., Anderson, D., & Nashon, S. (2008). Development of an instrument designed to investigate elements of science students' metacognition, self-efficacy and learning proceses: The SEMLI-S. *International Journal of Science Education, 30*(13), 1701–1724.

Tobias, S., & Everson, H. T. (2000). Assessing metacognitive knowledge monitoring. In G. Schraw & J. C. Impara (Eds.), *Issues on the measurement of metacognition* (pp. 147–222). Lincoln, NE: Buros Institute of Mental Measurements.

Tobias, S., & Everson, H. T. (2009). The importance of knowing what you know: A knowledge monitoring framework for studying metacognition in education. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 107–127). New York, NY: Routledge.

Veenman, M. V. J., & Spaans, M. A. (2005). Relation between intellectual and metacognitive skills: Age and task differences. *Learning and Individual Differences, 15,* 159–176.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1,* 3–14.

Veenman, M. V. J., & Verheij, J. (2003). Technical students' metacognitive skills: relating general vs. specific metacognitive skills to study success. *Learning and Individual Differences, 13,* 259–272.

Veenman, M. V. J., Wilhelm, P., & Beishuizen, J. J. (2004). The relation between intellectual and metacognitive skills from a developmental perspective. *Learning and Instruction, 14,* 89–109.

Vermunt, J. D., & Vermetten, Y. J. (2004). Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations. *Educational Psychology Review, 16*(4), 359–384.

Vrugt, A., & Oort, F. J. (2008). Metacognition, achievement goals, study strategies and academic achievement: Pathways to achievement. *Metacognition and Learning, 30,* 123–146.

Weaver, C. A. III (1990). Constraining factors in calibration of comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 214–222.

Weaver, C. A. III, & Bryant, D. S. (1995). Monitoring of comprehension: The role of text difficulty in metamemory for narrative and expository text. *Memory & Cognition, 23,* 12–22.

Weinstein, C. E., Zimmerman, S. A., & Palmer, D. R. (1988). Assessing learning strategies: The design and development of the LASSI. In C. Weinstein, E. T. Goetz, & P. A. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation* (pp. 25–40). San Diego, CA: Academic Press.

Whimbey, A., & Lochhead, J. (1986). *Problem solving and comprehension*. Hillsdale, NJ: Erlbaum.

White, B. Y., & Frederiksen, J. R. (1998). Inquiry, modeling, and metacognition: Making science accessible to all students. *Cognition and Instruction, 16*(1), 3–118.

White, B. Y., & Frederiksen, J. R. (2005). A theoretical approach and framework for fostering metacognitive development. *Educational Psychologist, 40*(4), 211–223.

White, B., Frederiksen, J., & Collins, A. (2009). The interplay of scientific inquiry and metacognition. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 175–205). Hillsdale, NJ: Erlbaum.

Whitebread, D., Bingham, S., Grau, V., Pasternak, D. P. & Sangster, C. (2007). Development of metacognition and self-regulated learning in young children: Role of collaborative and peer-assisted learning. *Journal of Cognitive Education and Psychology, 6*(3), 433–455.

Wiley, J., Griffin, T., & Thiede, K. W. (2005). Putting the comprehension into metacomprehension. *Journal of General Psychology, 132,* 408–428.

Williams, J. P., & Atkins, J. G. (2009). The role of metacognition in teaching reading comprehension to primary students. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 26–43). New York, NY: Routledge.

Wilson, N. S., & Bai, H. (2010). The relationships and impact of teachers' metacognitive knowledge and pedagogical understandings of metacognition. *Metacognition Learning, 5,* 269–288.

Winne, P. H., & Nesbit, J. C. (2010). The psychology of academic achievement. *Annual Review of Psychology, 61,* 653–678.

Winograd, P., & Gaskins, R. W. (1992). Metacognition: Matters of the mind, matters of the heart. In A. L. Costa, J. Bellanca, & R. Fogarty (Eds.), *If minds matter: A foreward to the future* (Vol. 1, pp. 225–238). Palatine, IL: Skylight.

Wirth, J., & Leutner, D. (2008). Self-regulated leaning as a competence: Implications of theoretical models for assessment methods. *Journal of Psychology, 216*(2), 102–110.

Zhao, Q., & Linderholm, T. (2008). Adult metacomprehension: Judgment processes and accuracy constraints. *Educational Psychology Review, 20,* 191–206.

Zimmerman, B. J. (1989). A social-cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81,* 329–339.

Zimmerman, B. J. (1995). Self-regulation involves more than metacognition: A social cognitive perspective. *Educational Psychologist, 30,* 217–221.

Zimmerman, B. J. (2001). Theories of self-regulated learning and academic achievement: An overview and analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 1–65). Mahwah, NJ: Erlbaum.

Zimmerman, B. J., & Moylan, A. R. (2009). Self-regulation: Where metacognition and motivation intersect. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 299–315). New York, NY: Routledge.

Zohar, A. & Peled, B. (2008). The effects of explicit teaching of metastrategic knowledge on low- and high-achieving students. *Learning and Instruction, 18,* 337–353.

CHAPTER 5

Motivation and Classroom Learning

ERIC M. ANDERMAN, DeLEON L. GRAY, AND YUJIN CHANG

MOTIVATION AND CLASSROOM LEARNING

Student academic motivation is a fundamental concern of teachers, parents, school administrators, and education researchers. Academic achievement is related in important and often complex ways to students' motivation. Nevertheless, although there is much agreement about the overall importance of motivation in education, an in-depth examination of the topic indicates that motivation is actually quite complex.

Academic motivation has been studied through a variety of lenses. Motivation is primarily examined by educational and psychological researchers. Nevertheless, the study of motivation is broad. Through an educational lens, motivation is studied within the content areas (e.g., mathematics, science); as a policy-related issue; as part of teacher education; and as a part of school leadership. Through a psychological lens, motivation is studied by educational, developmental, cognitive, and social psychologists. The study of motivation is therefore highly multidisciplinary, thus adding to the breadth and complexity of the topic.

In this chapter, we review current research on academic motivation. First, we examine several contemporary theoretical frameworks that guide research in academic motivation. These frameworks each examine different aspects of motivation. The theories and research reviewed in the first half of this chapter focus on theoretical and empirical explanations for a variety of beliefs, goals, and motives that students entertain before, during, and after participation with academic tasks. In addition, as we demonstrate, motivation does not just reside in the mind of the student; rather, motivation is related to a complex dynamic that transcends relationships between students, teachers, and the environments created in schools and classrooms.

In the second half of this chapter, we review research examining how motivation theory is applied in actual classroom settings. In particular, we focus on how teachers' choices regarding daily instructional tasks have profound effects on student motivation. We demonstrate in particular that repeated exposure to certain types of instructional practices can facilitate the development of either positive or negative motivational beliefs in a particular subject domain.

CONCEPTUAL FORMULATIONS

Several theoretical frameworks have been developed to explain various aspects of academic motivation. In a general sense, each of these perspectives addresses the reasons why students engage with various academic tasks. Nevertheless, as we describe next, each motivational theory focuses on specific aspects of task engagement. In the following sections, we provide some background information about prominent theories of achievement motivation in schools, as well as an update on recent developments within each framework.

Self-Determination Theory

Many theories of motivation are grounded in the notion that behavior is determined by forces that are both internal and external to the individual (Heider, 1958). In terms of internal forces, an individual's behavior can be directed and energized by sheer interest, or a natural tendency toward engaging in a particular behavior. *Intrinsic motivation* is therefore a desire to engage in an activity because the activity itself is fulfilling. For example, a student may choose to play the popular math game *Sudoku* in his or her spare time even though there are no clear incentives or punishments associated with doing so. People approach tasks for which they are intrinsically motivated with a greater curiosity and persistence (Deci, 1975), and experience vitality as a result of engaging in such tasks (Ryan, 1995). Self-determination theorists argue that humans are born with a natural curiosity to explore, understand, and learn about the world around them (Ryan & Deci, 2000a). However, external forces in our environments can support or undermine our natural proclivity to be self-driven. *Extrinsic motivation* is the performance of a behavior in service of a desired outcome (Ryan & Deci, 2000b). Deadlines, performance evaluations, and negative consequences are considered extrinsic motivators that contribute to feelings of pressure and, subsequently, reduce intrinsic motivation (Deci & Ryan, 1985, 2000a; Plant & Ryan, 1985). For example, a student who receives money for good grades may be extrinsically motivated to engage in learning activities at school because the student's allowance is contingent on his or her academic performance.

Self-determination theorists view intrinsic motivation as ideal. Still, being intrinsically motivated is not always possible due to societal pressures (Ryan & Deci, 2000a). Of primary importance is a person's perception of volition or will (Ryan & Deci, 2001). For this reason, self-determination theorists have moved away from the distinction between intrinsic and extrinsic motivation toward a distinction between self-determined (or autonomous) versus controlled motivation—where self-determined motivation represents a more internalized motive behind a person's activity engagement (Ryan & Deci, 2000a, 2008). C*ontrolled motivation* is the regulation of behavior by external contingencies (known as external regulation) or by contingencies of self-worth (known as *introjected regulation*). *Self-determined motivation* is the regulation of behavior by internal values (known as *identified regulation*), true acceptance of one's behavior as an integral aspect of one's sense of self (known as *integrated regulation*), and pure interest (known as *intrinsic regulation*).

Within education settings, self-determined motivation is the internalization of values and regulatory processes that result in learning, personal growth, and a conceptual understanding of academic content (Deci, Vallerand, Pelletier, & Ryan, 1991). According to the theory, self-determination can be facilitated through the satisfaction of three basic psychological human needs. These are the needs for *competence, relatedness,* and *autonomy*. *Competence*, which is conceptually equivalent to self-efficacy (Bandura, 1997), is a person's perceived ability to perform a task. *Relatedness,* or belonging (Baumeister & Leary, 1995), refers to an individual's established interpersonal connections with others. *Autonomy* is a person's perception that his or her behaviors are self-initiated (Deci et al., 1991). Of these three basic human needs, the promotion of autonomy has been the most studied among self-determination theorists within the education literature. Still, Ryan and Deci (2006) assert that this construct receives the most criticism and remains misunderstood by many scholars. Ryan and Deci explain autonomy as being distinct from individualism, separateness, and independence; instead, autonomy is the perception of one's choice. Additionally, evidence exists that the need for autonomy is in fact universal, (Ryan & Deci, 2006) and is not bound to certain cultures—as some scholars intuit (Iyengar & DeVoe, 2003).

Self-determination theory research has highlighted the importance of teachers' motivational styles—conceptualized along a continuum from controlling to autonomous—for facilitating desired learning outcomes among students. According to Reeve and Jang (2006), specific autonomy-supportive instructional practices include helping students without enabling them, welcoming student comments, listening, emphasizing effort, allotting individual work time, praising growth and improvement, being responsive to comments and concerns, and incorporating students' interests into the lesson.

In general, autonomy-supportive teachers are those who adopt students' perspectives, encourage them to be themselves in the classroom, and facilitate self-regulation (Reeve, 2009). Studies consistently have highlighted the positive function of autonomy-supportive teaching for students' motivation and performance. When teachers' motivational styles support students' psychological needs, students are more motivated to do homework (Katz, Kaplan, & Gueta, 2010); students are more actively involved and take more initiative when learning (Reeve, Jang, Carrell, Jeon, & Barch, 2004); students feel more engaged in their learning environment (Jang, Reeve, Ryan, & Kim, 2009); students experience positive affect (Patrick, Skinner, & Connell, 1993); students have more positive self-perceptions (Deci, Schwartz, Sheinman, & Ryan, 1981); and students exhibit deeper cognitive processing and perform better on tests (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Most recently, Jang, Reeve, and Deci (2010) have found that providing structure during classroom activities serves as a complementary instructional style to autonomy-supportive teaching practices. Jang et al. note that whereas autonomy support is important for students' overall academic engagement, teacher-provided structure (as opposed to chaos) appears to be important for sustaining students' attention, effort, and persistence on specific academic tasks.

Attribution Theory

When students receive performance feedback in school (e.g., a graded chemistry examination), students often are interested in the reasons behind their successes or failures. The question of "Why?" is extremely important, because a person's perception of the causes for failure or success lead to two outcomes. First, causality cues an individual into how he or she should feel about the event's outcome; second, causality determines how much a person wants to engage in a particular event (or task) in the future. Weiner's (1985) attribution theory explains that a person's achievement motivation and achievement-related emotions are determined by the conclusions they make about the bases of their successes or failures.

Weiner explains that there are three primary dimensions on which people make causal ascriptions. These dimensions are locus, stability, and controllability. *Locus of causality* is whether the event's outcome is due to forces that are internal or external to the individual. *Stability* represents a person's perception of whether a cause is stable over time. *Controllability* refers to an individual's perception of whether he or she has the capacity to dictate the outcome of the event. According to Weiner (1992), causes for success and failure can be classified based on these three categories. Among many possible causes, the two most frequently used attributions are to *ability*, which is generally considered internal, stable, and uncontrollable, and to *effort*, which is generally considered internal, unstable, and controllable.

Researchers have examined how these three dimensions of attributions are linked to achievement behaviors, expectancy beliefs, and emotions. According to Weiner (1986), individuals' perceptions of whether a cause is stable over time are closely related to their expectations for future success. For example, if a student attributes his or her failure on a math test to a stable cause such as low ability, the student is likely to have low expectations for success on future math tests. In terms of emotions, each dimension is related to different types of emotions (Weiner, 1985). Locus of causality is linked with pride and self-esteem. For example, when a student believes that she was the cause of her own success, the student is likely to experience pride and positive self-esteem. Weiner discusses stability as being associated with feelings of helplessness or hopefulness. For example, attributing a negative outcome to a stable cause brings out feelings of helplessness. Additionally, Weiner explains that perceived controllability can bring out feelings of shame or guilt. Attributing performance to controllable causes generates a perception of responsibility, unlike uncontrollable causes. For example, if a student thinks she failed a test because she did not work hard enough, she is likely to feel guilt because she feels that she is responsible for the unsatisfactory performance.

Individuals' attributions are also influenced by environmental factors, such as teacher feedback. Teachers may affect students' attribution patterns both in positive and negative ways. For example, when teachers offer unsolicited help, praise for success on an easy task, or express sympathy following failure, students may interpret these teacher behaviors as low-ability messages. Thus, these types of teacher feedback can damage the motivational beliefs of underachieving students (Graham, 1990, 1991). In contrast, teachers can help students to foster functional attributions by teaching them to attribute failure to controllable factors (e.g., lack of effort) rather than to uncontrollable factors (e.g., low ability). Research on attribution retraining indicates that attribution feedback can alter students' maladaptive attributions and improve their motivation and achievement (Craske, 1988; Dweck, 1975; Fowler & Peterson, 1981; Reyna, 2000).

Social Cognitive Theory

Social cognitive theory emphasizes a dynamic, interactive process among behavioral, personal, and environmental factors in order to explain human functioning. In this framework of *triadic reciprocality*, learning is viewed as a product of reciprocal interactions among these three influences. Social cognitive theory also makes a distinction between learning and performance in that people can learn without performing at the time they learn something. Learning often occurs through observing others' actions and the outcome of others' behaviors (*modeling*).

In the social cognitive theory, one of the key factors in relation to explaining human motivation and behavior is *self-efficacy*, which is defined as individuals' perceived capabilities to perform a specific task (Bandura, 1986, 1997). For example, if a student believes that he or she can solve a particular type of mathematical problem, the student has a high efficacy belief toward that type of problem. Bandura (1986) argued that people are unlikely to be motivated to act in certain ways if they do not believe they can achieve the outcome they desire. Self-efficacy is distinguished from *outcome expectancy*, which refers to one's estimation that a given action will lead to a certain outcome.

Self-efficacy is generally viewed as task- or domain-specific or situational, so it is distinguished from more global constructs including self-concept and self-esteem (Bandura, 1997; Linnenbrink & Pintrich, 2003; Pajares, 1996; Pajares & Schunk, 2001). Therefore, a student could have high-efficacy beliefs toward mathematical word problems while having low efficacy for mathematical graph problems. Individuals' efficacy for a certain task is determined by a function of their past experiences with the task, current and prior beliefs about the task, task features, and other situational factors.

According to Bandura (1997), self-efficacy beliefs are formed by interpreting information from four sources: (1) mastery experiences, (2) vicarious experiences, (3) social persuasion, and (4) physiological/affective arousal. Individuals' own previous experiences or mastery experiences for a task are the most influential sources, and one's self-efficacy can be lowered if he or she interprets the outcome of these experiences as unsuccessful. Self-efficacy also can be formed through observing other people perform a task (vicarious experience), as a result of receiving verbal encouragement or judgment from teachers, parents, or peers (social persuasion), or when individuals experience some physiological or emotional states such as stress, anxiety, and arousal (physiological/affective arousal). Bandura argued that the relation between self-efficacy and the hypothesized sources can vary depending on contextual features. Several empirical studies, mostly in the domain of mathematics, have examined the sources of self-efficacy in academic settings (Klassen & Usher, 2010; see Usher & Pajares, 2008, for a review).

Self-efficacy is known to be related to numerous academic outcomes. In particular, research suggests that self-efficacy is one of the strongest positive predictors of academic achievement (Bandura, 1997; Schunk, 1991; Schunk & Pajares, 2005). Studies demonstrate that the relation of self-efficacy to students' achievement remains significant even after controlling for prior knowledge and ability levels. In terms of motivational outcomes, self-efficacy is related to students' choice of activities, cognitive engagement, persistence, and resilience in the face of difficulty (Bandura, 1986; Bandura & Schunk, 1981; Pintrich & De Groot, 1990; see Schunk & Pajares, 2005). Students' perceived capabilities to do a task are also related to self-regulated learning variables including goal setting, self-monitoring, and use of learning strategies. Previous research findings suggest that self-efficacious students are more likely to set challenging goals, are better at self-monitoring, and tend to use cognitive strategies more than students with low efficacy, which leads efficacious students to show high achievement (Pintrich & De Groot, 1990; Zimmerman, 1994, 2000; Zimmerman & Bandura, 1994; Zimmerman, Bandura, & Martinez-Pons, 1992).

Social cognitive theorists also examine collective efficacy, which is the belief that one's group is capable of achieving some desired end (Bandura, 1997, p. 477). Collective efficacy is associated with group performance and their motivational beliefs (Kozlowski & Ilgen, 2006). A recent study by Klassen and Krawchuck (2009) examined adolescents' collective efficacy, group cohesion, and group performance working in small groups. Results indicated that cohesive groups were higher in collective efficacy; and among older adolescents in particular, working in these groups was related to better performance. Research demonstrates that students' perceptions of the interdependent nature of the task, along with students' perceptions of their group's interdependence, is associated with the development of collective efficacy (Alavi & McCormick, 2008). Most recently, Putney and Broughton (2011) examined the role of the teacher in students' perceptions of collective efficacy. The authors found that the teacher's role as a classroom community organizer was responsible for the development of students' collective efficacy.

Expectancy-Value Theory

Expectancy-value theories have generated abundant research about achievement motivation in classrooms. The first formal expectancy-value model developed by Atkinson (1957, 1964) was influenced by previous theorists such as Tolman (1932) and Lewin (1938), who initially conceptualized the expectancy and value constructs. In Atkinson's model (1957, 1964), individuals' achievement-oriented behaviors are determined as a function of their need for achievement (*motive for success*), expectations for success (*probability of success*), and values (*incentive value of success*). Unlike the later models of expectancy-value theory developed by other researchers, individuals' expectations for success and incentive values were inversely related in his model because of the assumption that people are likely to perceive higher incentive value when they accomplish more difficult tasks (low expectations for success) than when they complete easier tasks (high expectations for success).

The contemporary expectancy-value model of achievement choices developed by Eccles, Wigfield, and their colleagues (Eccles, 1987, 2005; Eccles [Parsons] et al., 1983; Wigfield & Eccles, 1992, 2000, 2002) expanded the theory by enriching the definitions of expectancy and value components and by incorporating a broad range of social and cultural factors as well as individual differences into the model. In their model, the two most important predictors of achievement-related choices and performance are the individual's expectations for success and subjective task values.

Expectations for success refer to the individuals' beliefs about how well they will perform on a task, and these beliefs are determined by one's self-concept of ability and perceptions of task difficulty. Although expectancies and ability beliefs are empirically closely related, they are theoretically different in that expectancies are one's beliefs about performance on future tasks, whereas ability beliefs are focused on one's current ability (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Wigfield & Eccles, 2000).

The four components of task value proposed in the model are (1) attainment value or importance, (2) intrinsic value or interest, (3) utility value or usefulness, and (4) cost. Attainment value refers to the importance of doing well on a particular task and it is closely related to one's self-image or identity. Intrinsic value, which refers to enjoyment one can gain through doing a task, is similar to *intrinsic motivation*. Utility value is defined as the perceived usefulness of a task toward helping one reach one's future goals. Cost is defined as negative valence, or the aversiveness of an activity due to potentially negative consequences (e.g., anticipated anxiety). Eccles (2009) also discussed cost in terms of the potential sacrifice one must make in order to engage in the task.

Several studies have examined how expectancy beliefs and task values develop as children age. Major findings indicate that even children as young as the first grade can distinguish between expectancy-related beliefs and task values within a given domain, and that their expectancy-related beliefs are domain specific. Findings also indicate that fifth graders and older children can differentiate the components of task value within a certain domain (Eccles & Wigfield, 1995; Eccles et al., 1993). One of the notable findings about development of expectancies and task values is that children's competency beliefs and their subjective values for particular academic tasks diminish over time, which was indicated in several longitudinal studies (Durik, Vida, & Eccles, 2006; Guthrie, Hoa, Wigfield, Tonks, & Perencevich, 2006; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Wigfield & Eccles, 2002). For example, a recent study by Archambault, Eccles, and Vida (2010) reported a decline in children's self-concept of ability and task value in literacy between Grade 1 and Grade 12. Wigfield and Eccles (2000) suggest two possible explanations for negative changes in students' motivational beliefs. One is that children become more realistic in their self-assessments as they engage in more social comparison and become better at interpreting evaluative feedback they receive. Second, school environmental factors that emphasize competition and evaluation can also lead to negative shifts in students' motivational beliefs.

Research based on expectancy-value models also has focused on how individuals' expectations for success and task values are related to their achievement-related decision making, persistence, degree of engagement, and performance, along with the influence of the determinants of these beliefs (e.g., Bong, 2001; Cole, Bergin, & Whittaker, 2008; Durik et al., 2006; Eccles et al., 1983; Guthrie et al., 2006; Simpkins, Davis-Kean, & Eccles, 2006; see Eccles, 2005, and Wigfield & Cambria, 2010a, for reviews). Findings of these studies indicate that if individuals believe they can accomplish a certain task and find doing the task important, useful, and enjoyable, they will probably choose to engage in the task, show persistence and deep levels of involvement, and be more likely to perform well on the task. More specifically, individuals' expectations for success have been reported to be a strong predictor of their actual performance on the task whereas task values are more strongly related to their decision to engage in learning (Eccles et al., 1983; Eccles, 2005; Wigfield & Cambria, 2010a). Compared to the expectancy component, which has been extensively studied as an important predictor of performance, relatively less attention has been paid to task values (Anderman & Wolters, 2006; Brophy, 1999; Wigfield & Eccles, 1992). Research indicates that task values have long-term effects on students' achievement-related behaviors (Durik et al., 2006; Simpkins et al., 2006). Among the four different components of task values, the cost component has been examined the least, although its importance to choice has been emphasized (Wigfield & Cambria, 2010a, 2010b). In Battle and

Wigfield's (2003) study, which examined cost as well as other value components, perceived cost negatively predicted college students' career decision to enter graduate school.

Whereas the aforementioned correlational research highlights associations of task values and behavioral choices, recent experimental studies demonstrate concrete ways of enhancing students' task values. Hulleman, Godes, Hendricks, and Harackiewicz (2010) manipulated utility value across two studies by asking college students to participate in a writing exercise. Compared to a control group, students who wrote about the relevance of academic subject matter to their lives exhibited higher academic interest and performance. Similarly, Hulleman and Harackiewicz (2009) found this values intervention to positively influence high school students' interest and course grades in science. The findings of these studies and others (e.g., Harackiewicz, 2012; Shechter, Durik, Miyamoto, & Harackiewicz, 2011) suggest that students' motivation and performance can be enhanced through simple manipulations of task values. Further, these findings contribute to a growing perspective that simple social-psychological interventions can have important impacts on educational outcomes (Gehlbach, 2010; Yeager & Walton, 2011).

Achievement Goal Theory

Achievement goal theorists are concerned with the reasons behind individuals' achievement-related behaviors. This focus makes achievement goal theory distinct from other conceptualizations of motivation (e.g., expectancy-value theory and social cognitive theory). Over the past three decades, researchers have extensively examined aspects of achievement goal theory (e.g., Ames & Archer, 1988; Dweck & Leggett, 1988; Elliot & Harackiewicz, 1996; Maehr & Anderman, 1993; Midgley et al., 1998; Pintrich, 2000a, 2000b). Whereas some individuals' motivation, affect, and achievement toward a particular task may reflect their preoccupation with learning, effort, and improvement, other individuals may be directed by their preoccupation with demonstrating their competence and ability (see Kaplan, Middleton, Urdan, & Midgley, 2002, for a detailed overview of achievement goal theory components). In the former case, such individuals are described as having a *mastery goal orientation* (also referred to as a task goal or a learning goal). In the case of the latter, such individuals are described as having a *performance goal orientation* (also referred to as an ego goal or an ability goal).

Individuals with performance goal orientations may be further classified as being preoccupied with demonstrating that they possess more competence than others or demonstrating that they are no less competent than others (Elliot, 1997, 1999; Elliot & Church, 1997; Middleton & Midgley, 1997). Thus, a performance-approach goal orientation is a person's orientation toward showing his or her high ability relative to others, whereas a performance-avoid goal orientation is a person's orientation toward avoiding the demonstration of an ability deficit. Some goal theorists have also classified mastery goal orientations in terms of approach and avoidance distinctions (Elliot, 1999; Pintrich, 2000b). A mastery-approach goal orientation is a person's orientation toward increasing expertise and truly understanding a task or concept. Alternatively, a mastery-avoid goal orientation can be thought of as the avoidance of a lack of understanding; in other words, it is a person's concern with forgetting a learned concept or failing to learn a concept within an allotted time period.

In achievement goal theory, the situational demands of a student's learning environment—known as context—play a role in producing learning outcomes (e.g., Ames, 1992; C. Ames & Ames, 1984; Wolters, 2004). Students' perceptions of teachers' emphasis on mastery or performance (otherwise known as classroom goal structures) impact the ways students approach academic tasks, and have impacts on important learning outcomes in both the short-term and long-term (Anderman & Wolters, 2006). Students perceive a classroom mastery goal structure when teachers stress the importance of gaining a deep understanding of the class material. For example, in a mastery-focused classroom, teachers might encourage students to increase their knowledge on a class topic relative to their current level of understanding. On the other hand, students perceive a classroom performance goal structure when teachers emphasize the idea that a student's worth is based on his or her capabilities. For example, teachers stress the importance of tests, grades, and class standing in performance-focused classrooms. In addition to classroom environments being characterized as emphasizing either a mastery or performance-goal structure, researchers also have examined perceptions of overall school environments in terms of perceived school goal structures as well (Maehr & Midgley, 1996).

Mastery goal orientations and mastery goal structures are associated with adaptive learning outcomes including increased help-seeking (Ryan & Pintrich, 1997), decreased self-handicapping (e.g., Midgley & Urdan, 2001), persistence in the face of difficulty (e.g., Elliott & Dweck, 1988; Stipek & Kowalski, 1989), the use of effective cognitive and metacognitive learning strategies (e.g., Elliot & McGregor, 2001; Meece & Miller, 2001).

Scholars such as Midgley et al. (2001) have generally argued that performance goal structures are maladaptive. For example, performance goal structures are associated with maladaptive learning outcomes such as increased academic cheating (e.g., Anderman, Griesinger, & Westerfield, 1998), increased self-handicapping (Urdan, Midgley, & Anderman, 1998), and the perception of failure as being indicative of a lack of ability (Ames & Archer, 1988). Unlike performance goal structures, however, associations between personal performance goal orientations and learning outcomes are not always found to be maladaptive. Harackiewicz, Barron, Pintrich, Elliot, and Thrash (2002) reported performance approach goal orientations as positively associated with a number of adaptive outcomes among students, including performance on tests and quizzes, positive attitudes toward learning, and task value. On the other hand, performance-avoid goal orientations are consistently associated with maladaptive outcomes including anxiety, low perceived ability and lower grades (Kaplan et al., 2002). Based on these findings and others, the constructs of performance-approach and avoid-goal orientations represent distinctions that are both conceptually and empirically meaningful to goal theorists.

Recent advancements have contributed to our increased understanding of the theoretical and practical importance of achievement goal theory in classrooms in terms of construct measurement (e.g., Koskey, Karabenick, Woolley, Bonney, & Denver, 2010), the application of the theory to non-traditional academic subject areas (e.g., Anderman, Cupp, Lane, Zimmerman, Gray, & O'Connell, 2011), and the specification of statistical models examining the effects of goals and goal structures (Murayama & Elliot, 2009). Koskey et al. (2010) employed systematic cognitive interviewing techniques to examine the congruence between students' interpretations of classroom goal structure scale items and the conceptual definitions of these constructs. Classroom goal structure items have been measured in two different ways: by having students respond to items about the climate of their classroom (e.g., "In my classroom, mistakes are okay in math as long as we are learning"), or by having students think about specific teacher practices (e.g., "My teacher thinks mistakes are okay in math as long as we are learning") (Midgley et al., 1998). Koskey et al. found that students accurately interpret mastery goal structure items containing the term *my teacher* as compared to the "in my classroom" mastery goal structure item stems. Anderman et al. (2011) expanded the study of achievement goal theory to health education. Specifically, they found mastery goal structures to be related to adaptive attitudes, intentions, and efficacy beliefs about HIV and pregnancy prevention both in the short term (one semester after students' health classes) and in the long term (1 year after students' health classes had ended). Conversely, the authors found performance goal structures to be related to both proximal and distal maladaptive attitudes, intentions, and efficacy beliefs about HIV and pregnancy prevention. The authors extend the study of achievement goal theory by highlighting the relevance of classroom goal structures for healthy life choices in one's personal life. Murayama and Elliot (2009) have developed an analytic framework for examining the joint influences of personal achievement goals and classroom goal structures simultaneously. The authors highlighted the ways in which personal achievement goals and classroom goal structures can work in concert to produce achievement-related outcomes. Murayama and Elliot encourage goal theorists to move beyond focusing solely on the direct impacts of either achievement goal orientations or classroom goal structures on achievement-related outcomes. Instead, researchers should consider the simultaneous effects of these constructs on learning outcomes—as achievement goal theory would predict.

Summary

We have reviewed five contemporary theories of academic motivation. Whereas it is possible to view these theories as competing models, our review indicates that each theory focuses on unique aspects of academic motivation. For example, whereas expectancy-value theory refers to individuals' beliefs about their expected abilities to complete tasks and their perceived valuing of those tasks, attribution theory focuses on individuals' beliefs and emotions after completion of various tasks. In the next section, we examine ways in which these theoretical frameworks have been applied to learning tasks in actual classrooms.

RESEARCH FINDINGS ON CLASSROOMS AND MOTIVATION

In the previous section, we reviewed current theoretical perspectives on academic motivation. Although these theories are well grounded in empirical data, practical applications of these theories are seen as they are employed at the classroom level. In this section, we examine how motivational theories are enacted in actual classrooms. More specifically, we examine in particular how motivation is enacted through instructional practices by teachers, and interpreted by students.

The Teacher Matters

One of the most fundamental findings in research on academic motivation is that the classroom teacher has a powerful influence on student motivation. Whereas students' motivational beliefs clearly develop over time and are based on students' histories and prior experiences in academic settings, students' present-day teachers still have important effects on academic motivation.

Although research examining teacher-effects on student motivation has been conducted for many years, studies conducted in recent years using a variety of different methodological approaches all converge on the notion that teachers do have an influence on student motivation at the classroom level. Brophy and Good noted quite early that the contexts created by teachers in classrooms are related to student learning in important ways (Brophy & Good, 1986; Good, Biddle, & Brophy, 1975). More recently, studies using sophisticated quantitative techniques such as multilevel regression (Raudenbush & Bryk, 2002) that partition variance both within and across groups have allowed researchers to examine variation in motivational variables across classrooms (E. M. Anderman & Young, 1994; Fast et al., 2010; Urdan et al., 1998). These studies indicate that after controlling for numerous background characteristics of students, motivation still varies across classrooms; in many of these studies, this across-classroom variation can be at least partially explained by the use by teachers of different types of instructional practices across settings. Other studies using qualitative methods also indicate that motivation varies greatly across classrooms as a result of differential instructional practices (Patrick, Anderman, Ryan, Edelin, & Midgley, 2001; Turner et al., 2002). Finally, other studies indicate that intervening at the classroom-level can enhance student motivation (Hulleman & Harackiewicz, 2009; Wentzel & Wigfield, 2007), thus suggesting that instruction can be changed within classrooms and can affect student motivation.

How Do Teachers Communicate Messages About Motivation to Students?

Teachers affect students via the types of instructional practices that they use in their classrooms. These practices send messages to students about the reasons why students engage in their academic work. Consider a classroom in which a teacher is working with students on a history unit examining the Revolutionary War. Teachers can approach the presentation of this topic in a number of ways. Specifically, one teacher might frame the discussion of this historic event as a topic that is important for students to learn because it will be on a major test; in contrast, another teacher might frame the discussion in terms of how an understanding of the American Revolutionary War might help us to better understand current events occurring in the Middle East. Framing the discussion in terms of its importance for an exam is likely to elicit controlled motivation, whereas framing the discussion in terms of its relation to contemporary events is more likely to elicit self-determined motivation (Ryan & Deci, 2009). In addition, these messages are conveyed to students both through the types of instructional practices (e.g., academic tasks, assignments, classroom activities) that are presented, and also through the discourse that teachers use with their students during actual instruction.

Instructional Practices Affect Motivation

The types of instructional practices that teachers use in their classrooms affect student motivation in important ways. The choices that teachers make on a daily basis about how they will present material, how they will reward students, how they will assess learning, how they will structure tasks, and how they will communicate all have important effects on students' goals, attributions, self-perceptions of competence, expectancies and values.

On a general level, educators frame students' self-determined and controlled motives through their daily interactions with students. If a teacher consistently talks about the importance of grades and test scores, students are likely to experience controlled motivation; in contrast, if a teacher spends time emphasizing the interesting aspects of a lesson or the inherent value of a subject, students may be more self-determined (E. Anderman & Anderman, 2010). Most importantly, these effects are likely to vary across classrooms, depending on the individual teacher (Good et al., 1975).

In the following sections, we review specific instructional practices that are commonly used in classrooms. In particular, we focus on research findings that indicate the relations between the implementation of these practices and motivational outcomes. We relate these findings in particular to the theoretical frameworks that were described in the previous section.

Using Rewards

Educators often use rewards during instruction. Rewards can take on many forms. Whereas the most common form of rewards used in classrooms is grades, numerous other types of rewards are used. The types of rewards that educators use vary depending on students' ages (E. Anderman & Anderman, 2010). For example, the use of gold stars may be common and quite effective with young children, but the presentation of a gold star might not be beneficial to early adolescents. In contrast, older students will value different types of rewards; examples of rewards commonly used with older students include the awarding of special privileges (e.g., being able to attend a special field trip), extra credit points, or sometimes vouchers (e.g., "get out of homework" passes).

Rewards and Academic Motivation

The primary concern with the use of rewards is best framed in terms of research on self-determined and controlled motivation. Studies indicate that extrinsic rewards can be particularly detrimental when they are administered in specific ways. In addition, the use of extrinsic rewards also can be particularly problematic when they are provided for activities in which individuals already display intrinsic interest. In an early study, Deci asked college students to perform a time-limited puzzle. Participants in the experimental condition were provided with $1 for each puzzle completed during a 13-minute period, whereas control participants received no monetary reward. Results indicated that participants' intrinsic motivation for the puzzles decreased when the monetary rewards were used (E. L. Deci, 1971).

In a similar study, Lepper and his colleagues (Lepper, Greene, & Nisbett, 1973) asked children to draw pictures in a preschool setting. Some students received an expected reward, some received an unexpected reward, and some received no reward. Results indicated that subsequent intrinsic motivation to draw decreased only for children in the condition in which they had expected to receive an award. Thus, Lepper and colleagues demonstrated that it is not just receiving a reward that is detrimental to intrinsic motivation, but also the expectation of receiving that reward. This finding was explained in terms of the *overjustification hypothesis*; specifically, if an individual is rewarded extrinsically for participation in an activity that the individual already is intrinsically motivated to complete, the presentation of the unnecessary reward will cause the learner to refocus the justification for his or her participation in the task toward the reward, rather than toward the intrinsic value of the task itself. Thus although the children in Lepper et al.'s study already had enjoyed drawing prior to the experimental task, the presentation of the reward overjustified their reasons for engaging with the task, and thus led to decreases in intrinsic motivation to draw.

Another concern about the use of rewards is related to whether the awards are perceived as informational or controlling. When rewards are perceived as informational, they are presented to students along with information about what the student has learned; such rewards are based on the student having demonstrated some particular level of performance on a task. In contrast, rewards can be perceived by students as controlling when the students do not receive any information about how they performed on the task. For example, when a teacher simply gives students rewards for having completed an assignment, the rewards will be perceived as controlling, whereas when a teacher gives students rewards for having demonstrated certain competencies, the rewards will be perceived as informational.

Empirical research indicates that the provision of informational rewards is more beneficial than is the provision of controlling rewards. Amabile and her colleagues conducted a now classic study in which college students were asked to complete a puzzle-like game under various conditions (Amabile, DeJong, & Lepper, 1976). These various conditions included two conditions with no deadlines, one with an implicit deadline (wherein participants were instructed to solve a minimum number of puzzles during a 15-minute period), and one with an explicit deadline (wherein participants were instructed to complete at least five puzzles within the time period for the results to be useful). Results indicated that participants in the conditions with deadlines experienced decreases in both behavioral and attitudinal indicators of interest in the game.

Other research indicates that when rewards are perceived as providing useful information to students, they may not be harmful to self-determined motivation (Boggiano, Harackiewicz, Bessette, & Main, 1985; Boggiano & Ruble, 1979; Swann & Pittman, 1977; Tripathi & Agarwal, 1988). Specifically, when rewards convey specific information to learners about their performance, intrinsic motivation does not decline. However, research also indicates that the developmental level of children must also be considered when examining the relations of the provision of rewards to self-determined motivation. For example, Boggiano and Ruble (1979) found that rewards that provided information about performance did not undermine intrinsic motivation in elementary-school aged children (ages 9 to 11) when they provided information on how the children compared with others; however, in preschool-aged children (approximately ages 4 to 6), effects were only found when information about performance was presented in terms of having met an absolute standard. Thus, the social comparative information was more important for the older children than for the younger ones.

There has been much debate in recent year regarding the effects of extrinsic rewards on intrinsic motivation. In particular, several large-scale reviews and meta-analyses have been completed on this topic. Whereas some argue that extrinsic rewards do not undermine intrinsic motivation (Cameron, Banko, & Pierce, 2001; Cameron & Pierce, 1994, 1996), others argue that negative effects are consistent and pervasive (Cameron & Pierce, 1996; E. L. Deci, Koestner, & Ryan, 1999a, 1999b, 2001; Kohn, 1996; Lepper, Keavney, & Drake, 1996). When making recommendations to practitioners, most researchers seem to support the notion that rewards can be used in educational settings, but with caution (see E. Anderman & Anderman, 2010). Specifically, when rewards are carefully selected, used judiciously, and provide information to students about what has been learned, then rewards will not decrease subsequent intrinsic motivation for a task. However, when rewards are administered haphazardly, and are allotted for the simple completion of tasks or for having completed work to meet a deadline, then intrinsic motivation may be harmed.

Evaluation Practices

The methods that educators use to evaluate learning also can influence student motivation; these influences can be both positive and negative. The ways in which educators discuss evaluation with their students, the ways that they help students to process and understand their grades and test scores, and the ways that educators provide remedial opportunities for students all greatly affect various aspects of motivation. Indeed, assessment of student learning is a complex topic, and decisions about the types of assessments that should be used in specific situations should not be made without careful consideration (Brookhart, 2004).

When examining the relations between motivation and evaluation, it is important to consider the different tools that educators can use to evaluate student learning. One important distinction in the literature involves the use of formative verses summative assessment (Karpinsiki & D'Agostino, in press). Formative assessments are usually low-stakes assessments that are designed to provide feedback to teachers and students regarding learning, whereas summative assessments are usually higher-stakes assessments that provide a broader indication of student learning at the end of a unit or a course of study. Another distinction involves the use of assessments that are created by teachers, verses standardized assessment instruments that are available and packaged with preexisting curricula. Whereas standardized assessment packages may be convenient, they cannot be easily tailored to the motivational needs of a particular set of students. Evaluation also can be accomplished with the use of authentic assessments (i.e., those that closely resemble actual tasks that individuals must perform in real-world settings) (Valencia, Hiebert, & Afflerbach, 1994), portfolio assessments (i.e., allowing students to display, either on paper or electronically, representations of their best works) (Bennett & Wadkins, 1995), and observational assessments (see E. Anderman & Anderman, 2010, for a review).

Evaluation Practices and Motivation

Research from a variety of theoretical perspectives indicates that the ways that evaluation practices and messages about results of evaluations are communicated to students affect various indicators of motivation. Indeed, students' motivational beliefs about tests and assessments vary considerably (K. E. Ryan, Ryan, Arbuthnot, & Samuels, 2007). In general, research suggests that although a focus on the importance of tests may lead to higher scores for some high achieving students, a focus on tests and testing also can lead to decrements in positive aspects of motivation (Nichols & Berliner, 2007).

On a general level, decisions about the scoring of assessments using either norm-referenced or criterion-referenced scoring systems can affect motivation. Norm-referenced scoring-systems allow for the direct comparison of one student's score with the scores of other students, whereas criterion-referenced scoring systems refer to assessments wherein students' scores are based on how well they have demonstrated specific skills. As we review later, the types of assessment rubrics that are selected can affect motivation in important ways.

Research from an achievement goal theory perspective indicates that the types of instructional practices and discourse that teachers use in the classroom are related to the types of achievement goal structures that students perceive in the classroom. Specifically, when teachers focus their instruction on engagement in meaningful academic tasks, on student effort, and on task-mastery, students are likely to perceive mastery goal structures; in contrast, when teachers focus their instruction on tests, test scores, and relative ability (i.e., ability comparisons between students), students are likely to perceive performance goal structures (Ames, 1992; L. H. Anderman, Patrick, Hruda, & Linnenbrink, 2002; Kaplan et al., 2002; Meece, Anderman, & Anderman, 2006; Midgley, 2002; Patrick et al., 2001; Turner et al., 2002; Urdan, Ryan, Anderman, & Gheen, 2002).

The use of instructional practices that emphasize performance goals can be detrimental to student motivation. For example, in a longitudinal study of children and adolescents, Anderman, Eccles, and their colleagues found that when students were exposed to performance-oriented instructional practices over the course of an academic year (e.g., displaying the best work as an example to motivate others), students' valuing of both reading and mathematics declined (E. M. Anderman, Eccles, et al., 2001). Results of this study and related work have important implications for motivating students to enter STEM disciplines in particular: Whereas teachers may believe that they are enhancing student motivation by emphasizing testing and relative ability, short-term gains in test scores may be occurring simultaneously with decrements in the valuing of STEM subjects; this is troubling, because achievement values are predictive of subsequent enrollment in courses (Wigfield & Eccles, 1992, 2000).

The selection of norm-referenced scoring criteria also may lead to the adoption of performance goals. By definition, norm-referenced scores focus on relative ability differences between students (i.e., scores are based on how well a student has performed relative to classmates) (E. M. Anderman, 2008). If students are assessed using a normative framework, they are likely to focus on social comparisons of their individual performances to those of other students. Consequently, they may adopt performance-approach or avoid goals; as aforementioned, the adoption of performance-avoid goals in particular is related to a host of maladaptive educational outcomes (Elliot & Harackiewicz, 1996; Harackiewicz et al., 2002).

High-stakes testing. It is particularly important in the era of No Child Left Behind to comment on the relations between the use of high-stakes standardized assessments and motivation (Nichols & Berliner, 2005). Ryan and his colleagues have argued that the widespread use of high-stakes testing focuses students and teachers on rewards and punishments, rather than on the academic content being taught (R. M. Ryan & Brown, 2005; R. M. Ryan & Deci, 2009). In addition, this focus constrains teachers' instructional practices in the classroom, such that teachers exhibit more controlling behaviors when they are working in school contexts that are highly focused on the outcomes of standardized assessments.

There is empirical support for this proposal. Flink and her colleagues (Flink, Boggiano, & Barrett, 1990) conducted a study in which fourth-grade teachers were asked to provide lessons on anagrams and sequencing problems. Teachers in the experimental condition were told that it was their responsibility to assure that their students performed up to standards, and their students "should be able to do well" if tested, whereas teachers in the control condition were told "simply to help the students learn how to solve the problems" (p. 918). Results indicated that students who were exposed to teachers in the experimental condition who used controlling strategies suffered subsequent performance decrements.

Selecting Appropriate Academic Tasks

One of the most basic and important decisions that teachers make on a daily basis involves the selection of appropriate academic tasks. This is a decision that is made by preschool educators, elementary school teachers, middle/high school teachers, and college professors. Indeed, the type of task that is presented to students can shape the students' values, attributions, and goals in important and sometimes enduring ways. Academic tasks can be selected in a variety of ways. Some educators use tasks or activities that are available in prepackaged curricula, whereas others develop their own tasks, or alter prepackaged activities to meet specific needs. Regardless of how tasks are selected, it is important for educators to consider the motivational implications of these choices.

Doyle (1983) provided a useful description of the different types of tasks that educators typically use in classrooms. Doyle noted that the type of task that is selected has important effects on student engagement. These four types of tasks include (1) memory tasks (i.e., memorizing or recognizing specific factual information), (2) procedural tasks (i.e., applying an algorithm such as a math formula to solve a problem), (3) comprehension/understanding tasks (i.e., being able to explain why a particular mathematical formula is being applied to a specific problem), and (4) opinion tasks (i.e., providing opinions about how the United States should respond to natural disasters that occur in other parts of the world).

Academic Tasks and Motivation

From a motivation perspective, it is important for educators to choose tasks that match the goals of the lesson and the abilities of the students. An opinion task might not be appropriate when teaching third graders how to write fractions, whereas a memory task might be inappropriate when trying to get high school seniors to think about the differences between political conservatism and liberalism. Thus the taxonomy provided by Doyle serves as a reminder for educators regarding the relations between task-choice and student engagement.

Expectancy-value theory provides an empirical and theoretical basis for the relations of academic tasks to achievement motivation. Task-values are by definition subjective, because the values that individuals have for various academic tasks and content areas vary across individuals (Wigfield, Tonks, & Lutz Klauda, 2009). As we reviewed earlier in this chapter, subjective task-values consist of four components (attainment value, utility value, intrinsic value, and cost) (Wigfield & Eccles, 1992). Subjective task-values are extremely important, because they predict future engagement with activities and academic domains (Durik et al., 2006; Eccles [Parsons], et al., 1983; Wigfield & Eccles, 1992). In addition, research clearly indicates that task-values develop over time and are shaped by students' experiences in school and with various academic tasks and subject areas (Wigfield & Eccles, 1992, 1994).

Teachers' interactions with students convey important messages about motivation, and influence learning outcomes in important ways (McCroskey, Richmond, & Bennett, 2006). More specifically, the ways that teachers communicate with their students about the value of various academic tasks affects how students process information and develop long-term achievement values toward those tasks. Thus a teacher who takes the time to explain to students why a particular task or activity is important, useful, or worth the investment of some time may foster the development of more adaptive motivational beliefs (i.e., subjective task-values) than teachers who simply explain the provision of various activities as requirements that must be met.

Achievement goal theory also provides a theoretical framework for examining the relations between task selection and academic motivation. As previously reviewed, when students hold mastery goals (more specifically, mastery-approach goals), their goals involve truly mastering the task that they are working on (Ames & Archer, 1988; E. M. Anderman, Austin, & Johnson, 2001; Dweck & Leggett, 1988). Students who are mastery-goal oriented use themselves and their previous levels of performance on a task as reference points (as opposed to comparisons with other students), and tend to make attributions to effort.

Students' adopt achievement goals based on the ways in which academic tasks are presented. Indeed, the adoption of mastery (versus performance) goals is related strongly to how teachers communicate about tasks, and how teachers assess learning outcomes for various tasks. When the classroom goal structure is perceived as one that focuses students on learning, effort, and improvement (i.e., a perceived mastery-goal structure), then students are likely to adopt mastery goals (Ames, 1992; Ames & Ames, 1984; Kaplan et al., 2002; Meece et al., 2006).

When teachers put structures in place that foster the development of mastery goals, such goals are likely to be adopted by students. Again, teacher communication with students about the purposes of various tasks is an important precursor to mastery goal adoption. Structures that are likely to foster the development of mastery goals toward specific academic tasks include the relaxing of strict deadlines; grading based on effort and improvement as well as achievement; encouraging and rewarding creativity; and avoiding the use of high-stakes assessments when possible (Maehr & Anderman, 1993).

Summary

Whereas a variety of frameworks exist to explain academic motivation, these various theoretical perspectives all must be considered within the social contexts of schools and classrooms where students actually learn. Educators make important decisions about how to allocate rewards, how to assess learning, and how to present tasks on a daily basis. Long-term exposure of students to a particular type of academic procedure or policy can affect motivation. For example, a student who is presented with academic tasks in biology that focus on projects involving interactions with various organisms is likely to have a different type of experience from a student who learns the same material via text books and worksheets.

DISCUSSION

Academic motivation is complex. As we have tried to demonstrate in this chapter, motivation is not a simple variable that can be operationalized easily and affected universally. Rather, motivation is complex, involving cognitive, affective, and behavioral variables. These variables all have developmental qualities (i.e., they do not function the same way in young children as they do in older adolescents), are related to individual differences (e.g., gender, ethnicity, academic achievement) and are affected by the social contexts of classrooms, schools, neighborhoods, and cultures.

In academic settings, motivation is related in important ways to the types of tasks that students encounter. In addition, motivation is related to the timing in which one considers the task (i.e., when the task is first introduced; while the student is engaged with the task; while preparing for an assessment; during the actual assessment; and processing feedback after an assessment has been completed). Thus, academic motivation is strongly influenced by a host of complex variables.

We have reviewed several of the most prominent contemporary motivation theories in this chapter. All of these theories differentially address the ways in which students think about academic tasks. From a motivation perspective, students consider (a) whether they are engaging in tasks for self-determined or controlled reasons (E. Deci, 1975; Lepper, Corpus, & Iyengar, 2005; R. M. Ryan & Deci, 2000a), (b) how to attribute their successes and failures at tasks (Weiner, 1985), (c) their beliefs about their abilities to successfully engage with and complete academic tasks (Bandura, 1986, 1997; Schunk, 1995), (d) their expectancies for success and values for academic tasks (Eccles [Parsons], et al., 1983; Wigfield & Eccles, 2000), and (e) the types of goals to adopt when engaging with tasks (Ames & Archer, 1988; Dweck & Leggett, 1988; Elliot & McGregor, 2001; Maehr & Zusho, 2009; Nicholls, 1989).

Whereas these variables often are described in terms of their relations to students' beliefs and achievement, it is important to recognize that teachers play an important role in shaping the development of these various goals, attributions, values, and beliefs (E. M. Anderman, 2002; E. M. Anderman, Maehr, & Midgley, 1999). In particular, decisions that teachers make on a daily basis affect student motivation. These decisions include decisions about the types of reward structures that will be used, the ways in which student learning will be evaluated, and the specific types of academic tasks that will be presented to students. Whereas these decisions may seem minor in nature, they have long-term effects on the development of motivational beliefs in students (E. Anderman & Anderman, 2010).

Areas for Future Research

There are many unanswered questions in the domain of academic motivation. One area that is ripe for future research is in the area of motivation-focused interventions. Wigfield and Wentzel recently edited a special-edition of the journal *Educational Psychologist* that focused on interventions that are designed to enhance motivation (Wigfield & Wentzel, 2007). Whereas this special issue provided insights into important intervention work in the field of motivation, it also brought to our attention the fact that little work in the field in recent years has focused on interventions. This is problematic, but certainly an area for growth. A probable reason for the lack of research designed to directly enhance positive aspects of motivation is the fact that motivation has not been considered by many as an important dependent variable; this was true in the 1970s (Maehr, 1976), and continues to be true today (E. M. Anderman & Weber, 2009). Whereas motivation variables often are included in research studies as independent or control variables, they are seldom considered as outcome variables.

Another area that has received little attention is the relation between academic motivation and cognitive neuroscience. Whereas some initial studies have been conducted examining the relations between academic motivation and physiological indicators, research in this area is scant (Fisher, Marshall, & Nanayakkara, 2009). Virtually no research has examined how achievement goals, beliefs about ability, values, and attributions operate at a neuronal level. Research in this area is particularly important, because many educators and policy-makers maintain beliefs about the relations between physiological variables and motivation that are unsupported, such as the belief that motivation during adolescence is directly tied to pubertal development (E. M. Anderman & Mueller, 2010).

In addition, there are other questions that simply remain unanswered and will require more precise studies. For example, the relations between performance-approach goals and academic achievement, and mastery goals and academic achievement, are still hotly debated, since findings across studies are inconsistent (Harackiewicz, et al., 2002; Kaplan & Middleton, 2002; Linnenbrink-Garcia, Tyson, & Patall, 2008). Although early studies often did not disaggregate performance-approach and performance-avoid goals, most studies in recent years have disaggregated these types of goals, yet results are still inconsistent. Part of this is because the relations between goal orientations and achievement are complex, and involve an array of mediators and moderators that also must be considered. Thus research using an achievement goal theory framework in particular is still nascent (Senko, Hulleman, & Harackiewicz, 2011).

The study of academic motivation also could benefit from more investigations that cut across theories to provide insight into important aspects of learning including (but not limited to) self-regulation, procrastination, self-handicapping, and overachievement. Interesting questions and new perspectives can emerge as researchers integrate theoretical principles and constructs. Vansteenkiste, Smeets, Soenens, Lens, Matos, and Deci (2010) highlighted one intersection between self-determination theory and achievement goal theory. The authors demonstrated that students can have either autonomous or controlled reasons for adopting performance approach goals. For example, a student with an autonomously regulated performance-approach goal might find the idea of outperforming other students to be highly stimulating, challenging, and personally valuable, whereas a student with a control-regulated performance-approach goal might desire to outperform other students for reasons of social pressure or guilt. Vansteenkiste et al. found that autonomously regulated performance approach goals were related to cheating, engagement, complex cognitive processing, selecting main ideas, concentration, meta-cognition, and test anxiety in adaptive ways, whereas control-regulated performance approach goals were related to these outcomes in maladaptive ways. Indeed, research hypotheses and ultimately recommendations for practice should contain some theoretical basis. It is important to point out that research conducted across theoretical lines is still grounded in theory. We place limits on the scientific advancement of motivational processes in schools if research is only conducted within the boundaries of our theoretical perspectives. Regardless of whether or not our discoveries fit neatly into a theoretical perspective, our work should enhance how psychologists, educators, and policy makers understand academic motivation.

Conclusion

The study of academic motivation has a long history, and is still in a state of development (Weiner, 1990). Whereas numerous theoretical perspectives exist and have developed over time, theories are still changing as new empirical results emerge. Given the emphasis placed on student achievement by policymakers, government officials, and researchers who compare achievement of students across cultures, it will be particularly important to continue to examine the relations between motivation and achievement.

Teachers, parents, and school administrators play important roles in this area, and researchers must be cognizant of this. Academic motivation does not simply reside in the mind of the student; rather, student motivation involves complex interactions between students and others who co-participate in instruction (Hickey & McCaslin, 2001). Researchers, educators, and policy makers will need to work together to implement strategies, interventions, and policies that build on the large body of extant research on motivation in order to improve academic achievement for all learners.

REFERENCES

Alavi, S. B., & McCormick, J. (2008). The roles of perceived task interdependence and group members' interdependence in the development of collective efficacy in university student group contexts. *British Journal of Educational Psychology, 78,* 375–393.

Amabile, T. M., DeJong, W., & Lepper, M. R. (1976). Effects of externally imposed deadlines on subsequent intrinsic motivation. *Journal of Personality and Social Psychology, 34,* 92–98.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84,* 261–271.

Ames, C., & Ames, R. (1984). Student motivation. In R. Ames (Ed.), *Research on motivation in education* (Vol. 1). Orlando, FL: Academic Press.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Student learning strategies and motivation processes. *Journal of Educational Psychology, 80,* 260–267.

Anderman, E. M. (2002). School effects on psychological outcomes during adolescence. *Journal of Educational Psychology, 94,* 795–809.

Anderman, E. M. (2008). Normal distribution. In E. M. Anderman & L. H. Anderman (Eds.), *Psychology of classroom learning* (pp. 648–650). Farmington Hills, MI: Cengage.

Anderman, E. M., & Anderman, L. H. (2010). *Classroom motivation*. Upper Saddle River, NJ: Pearson.

Anderman, E. M., Austin, C. C., & Johnson, D. M. (2001). The development of goal orientation. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation. A volume in the educational psychology series* (pp. 197–220). San Diego, CA: Academic Press.

Anderman, E. M., Cupp, P. K., Lane, D. R., Zimmerman, R., Gray, D. L., & O'Connell, A. A. (2011). Classroom goal structures and HIV/pregnancy prevention education in high school. *Journal of Research on Adolescence, 21,* 904–922.

Anderman, E. M., Eccles, J. S., Yoon, K. S., Roeser, R. W., Wigfield, A., & Blumenfeld, P. (2001). Learning to value math and reading: Individual differences and classroom effects. *Contemporary Educational Psychology, 26,* 76–95.

Anderman, E. M., Griesinger, R., & Westerfield, G. (1998). Motivation and cheating during early adolescence. *Journal of Educational Psychology, 90,* 84–93.

Anderman, E. M., Maehr, M. L., & Midgley, C. (1999). Declining motivation after the transition to middle school: Schools can make a difference. *Journal of Research and Development in Education, 32,* 131–147.

Anderman, E. M., & Mueller, C. (2010). Middle school transitions and adolescent development. In J. L. Meece & J. S. Eccles (Ed.), *Handbook of research on schools, schooling, and human development* (pp. 198–215). New York, NY: Routledge.

Anderman, E. M., & Weber, J. (2009). Continuing motivation revisited. In A. Kaplan, S. Karabenick, & E. DeGroot (Eds.), *Culture, self, and motivation: Essays in honor of Martin L. Maehr* (pp. 3–19). Charlotte, NC: Information Age.

Anderman, E. M., & Wolters, C. (2006). Goals, values, and affect: Influences on student motivation. In P. Alexander & P. Winne (Eds.), *Handbook of educational psychology* (2nd ed., pp. 369–389). Mahwah, NJ: Erlbaum.

Anderman, E. M., & Young, A. J. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching, 31*(8), 811–831.

Anderman, L. H., Patrick, H., Hruda, L. Z., & Linnenbrink, E. A. (2002). Observing classroom goal structures to clarify and expand goal theory. In C. Midgley (Ed.), *Goals, goal structures, and patterns of adaptive learning* (pp. 243–278). Mahwah, NJ: Erlbaum.

Archambault, I., Eccles, J. S., & Vida, M. N. (2010, October 4). Ability self-concepts and subjective value in literacy: Joint trajectories from grades 1 through 12. *Journal of Educational Psychology.* Advance online publication. doi: 10.1037/a0021075

Atkinson, J. W. (1957). Motivational determinants of risk taking behavior. *Psychological Review, 64,* 359–372.

Atkinson, J. W. (1964). *An introduction to motivation*. Princeton, NJ: Van Nostrand.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41,* 586–598.

Battle, A., & Wigfield, A. (2003). College women's value orientations toward family, career, and graduate school. *Journal of Vocational Behavior, 62,* 56–75.

Baumeister, R., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117,* 497–529.

Bennett, R. E., & Wadkins, J. (1995). Interactive performance assessment in computer science: The advanced placement computer science (APCS) practice system. *Journal of Educational Computing Research, 12*(4), 363–378.

Boggiano, A. K., Harackiewicz, J. M., Bessette, J. M., & Main, D. S. (1985). Increasing children's interest through performance-contingent reward. *Social Cognition, 3*(4), 400–411.

Boggiano, A. K., & Ruble, D. N. (1979). Competence and the overjustification effect: A developmental study. *Journal of Personality and Social Psychology, 37,* 1462–1468.

Bong, M. (2001). Role of self-efficacy and task value in predicting college students' course enrollments and intentions. *Contemporary Educational Psychology, 26,* 553–570.

Brookhart, S. M. (2004). Classroom Assessment: Tensions and Intersections in Theory and Practice. *Teachers College Record, 106,* 429–458.

Brophy, J. E. (1999). Towards a model of the value aspects of motivation in education: Developing an appreciation for particular learning domains and activities. *Educational Psychologist, 34,* 75–85.

Brophy, J. E., & Good, T. L. (1986). Teacher behavior and student achievement. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 328–375). New York, NY: Macmillan.

Cameron, J., & Pierce, W. D. (1994). Reinforcement, reward, and intrinsic motivation: A meta-analysis. *Review of Educational Research, 64,* 363–423.

Cameron, J., & Pierce, W. D. (1996). The debate about rewards and intrinsic motivation: Protests and accusations do not alter the results. *Review of Educational Research, 66*(1), 39–51.

Cameron, J., Banko, K. M., & Pierce, W. D. (2001). Pervasive negative effects of rewards on intrinsic motivation: The myth continues. *Behavior Analyst, 24*(1), 1–44.

Cole, J. S., Bergin, D. A., & Whittaker, T. A. (2008). Predicting student achievement for low stakes testing with effort and task value. *Contemporary Educational Psychology, 33,* 609–624.

Craske, M. (1988). Learned helplessness, self-worth motivation and attribution retraining for primary school children. *British Journal of Educational Psychology, 58,* 152–164.

Deci, E. (1975). *Intrinsic motivation*. New York, NY: Plenum Press.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*(1), 105–115.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999a). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125*(6), 627–668.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999b). The undermining effect is a reality after all—Extrinsic rewards, task interest, and self-determination: Reply to Eisenberger, Pierce, and Cameron (1999) and Lepper, Henderlong, and Gingras (1999). *Psychological Bulletin, 125*(6), 692–700.

Deci, E. L., Koestner, R., & Ryan, R. M. (2001). Extrinsic rewards and intrinsic motivation in education: Reconsidered once again. *Review of Educational Research, 71*(1), 1–27.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York, NY: Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11,* 227–268.

Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life's domains, *Canadian Psychology, 49,* 14–23.

Deci, E. L., Schwartz, A., Sheinman, L., & Ryan, R. M. (1981). An instrument to assess adult's orientations toward control versus autonomy in children: Reflections on intrinsic motivation and perceived competence. *Journal of Educational Psychology, 73,* 642–650.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26,* 325–346.

Doyle, W. (1983). Academic work. *Review of Educational Research, 53,* 159–199.

Durik, A. M., Vida, M., & Eccles, J. S. (2006). Task values and ability beliefs as predictors of high school literacy choices: A developmental analysis. *Journal of Educational Psychology, 98,* 382–393.

Dweck, C. S. (1975). The role of expectations and attributions in the alleviation of learned helplessness. *Journal of Personality and Social Psychology, 31,* 674–685.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95,* 256–273.

Eccles, J. S. (1987). Gender roles and women's achievement-related decision. *Psychology of Women Quarterly, 11,* 135–172.

Eccles, J. S. (2005). Subjective task values and the Eccles et al. model of achievement related choice. In A. J. Elliott & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). New York, NY: Academic Press.

Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*(2), 78–89.

Eccles (Parsons), J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75–146). San Francisco, CA: W. H. Freeman.

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and Social Psychology Bulletin, 21,* 215–225.

Eccles, J. S., Wigfield, A., Harold, R., & Blumenfeld, P. B. (1993). Age and gender differences in children's self- and task perceptions during elementary school. *Child Development, 64,* 830–847.

Elliot, A. J. (1997). Integrating the "classic and contemporary" approaches to achievement motivation: A hierarchical model of approach and avoidance achievement motivation. In M. L. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement,* (Vol. 10, pp. 143–179). Greenwich, CT: JAI.

Elliot, A. J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist, 34*, 169–189.

Elliot, A. J., & Church, M. A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 72,* 218–232.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54,* 5–12.

Elliot, A. J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology, 70,* 461–475.

Elliot, A. J., & McGregor, H. A. (2001). A 2 * 2 achievement goal framework. *Journal of Personality and Social Psychology, 80* (3), 501–519.

Fast, L. A., Lewis, J. L., Bryant, M. J., Bocian, K. A., Cardullo, R. A., Rettig, M., & Hammond, K. A. (2010). Does math self-efficacy mediate the effect of the perceived classroom environment on standardized math test performance? *Journal of Educational Psychology, 102* (3), 729–740.

Fisher, K. R., Marshall, P. J., & Nanayakkara, A. R. (2009). Motivational orientation, error monitoring, and academic performance in middle childhood: A behavioral and electrophysiological investigation. *Mind, Brain, and Education, 3* (1), 56–63.

Flink, C., Boggiano, A. K., & Barrett, M. (1990). Controlling teaching strategies: Undermining children's self-determination and performance. *Journal of Personality and Social Psychology, 59* (5), 916–924.

Fowler, J. W., & Peterson, P. L. (1981). Increasing reading persistence and altering attributional style of learned helpless children. *Journal of Educational Psychology, 73,* 251–260.

Gehlbach, H. (2010). The social side of school: Why teachers need social psychology. *Educational Psychology Review, 22,* 349–362.

Good, T. L., Biddle, B. J., & Brophy, J. E. (1975). *Teachers make a difference*. Oxford, UK: Holt, Rinehart & Winston.

Graham, S. (1990). On communicating low ability in the classroom. In S. Graham & V. Folkes (Eds.), *Attribution theory: Applications to achievement, mental health, and interpersonal conflict* (pp. 17–36). Hillsdale, NJ: Erlbaum.

Graham, S. (1991). A review of attribution theory in achievement contexts. *Educational Psychology Review, 3,* 5–39.

Guthrie, J. T., Hoa, L. W., Wigfield, A., Tonks, S. M., & Perencevich, K. C. (2006). From spark to fire: Can situational reading interest lead to long-term reading motivation? *Reading Research and Instruction, 45,* 91–117.

Harackiewicz, J. M. (2012, January). *Helping parents motivate their teens in mathematics and science.* Paper presented at the Annual Meeting of the Society for Personality and Social Psychology, San Diego, CA.

Harackiewicz, J. M., Barron, K. E., Pintrich, P. R., Elliot, A. J., & Thrash, T. M. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology, 94,* 638–645.

Heider, E (1958). *The psychology of interpersonal relations.* New York, NY: Wiley.

Hickey, D. T., & McCaslin, M. (2001). A comparative, sociocultural analysis of context and motivation. In S. Volet & S. Jarvela (Eds.), *Motivation in learning contexts: Theoretical advances and methodological implications* (pp. 33–55). Elmsford, NY: Pergamon Press.

Hulleman, C. S., Godes, O., Hendricks, B., & Harackiewicz, J. M. (2010). Enhancing interest and performance with a utility value intervention. *Journal of Educational Psychology, 102,* 880–895.

Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *Science, 326* (5958), 1410–1412.

Iyengar, S. S., & DeVoe, S. E. (2003) Rethinking the value of choice: considering cultural mediators of intrinsic motivation, *Nebraska Symposium on Motivation 49*, 129–74.

Jacobs, J., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Ontogeny of children's self-beliefs: Gender and domain differences across grades one through 12. *Child Development, 73,* 509–527.

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It's not autonomy support or structure, but autonomy support and structure. *Journal of Educational Psychology, 102*, 588–600.

Jang, H., Reeve, J., Ryan, R. M., & Kim, A. (2009). Can self-determination theory explain what underlies the productive, satisfying learning experiences of collectivistically oriented Korean students? *Journal of Educational Psychology, 101,* 644–661.

Kaplan, A., & Middleton, M. J. (2002). Should childhood be a journey or a race? Response to Harckiewicz et al. (2002). *Journal of Educational Psychology, 94,* 646–648.

Kaplan, A., Middleton, M. J., Urdan, T., & Midgley, C. (2002). Achievement goals and goal structures. In C. Midgley (Ed.), *Goals, goal structures, and patterns of adaptive learning* (pp. 21–53). Mahwah, NJ: Erlbaum.

Karpinsiki, A. C., & D'Agostino, J. V. (in press). The role of formative assessment in student achievement. In J. Hattie & E. M. Anderman (Eds.), *International handbook of student achievement.* New York, NY: Routledge.

Katz, I., Kaplan, A., & Gueta, G. (2010). Students' needs, teachers' support, and motivation for doing homework: A cross-sectional study. *Journal of Educational Psychology, 78,* 246–267.

Klassen, R. M., & Krawchuk, L. L. (2009). Collective motivation beliefs of early adolescents working in small groups. *Journal of School Psychology, 47,* 101–120.

Klassen, R. M., & Usher, E. L. (2010). Self-efficacy in educational settings: Recent research and emerging directions. In T. C. Urdan & S. A. Karabenick (Eds.), *Advances in motivation and achievement: Vol. 16A. The decade ahead: Theoretical perspectives on motivation and achievement* (pp. 1–33). Bingley, UK: Emerald.

Kohn, A. (1996). By all available means: Cameron and Pierce's defense of extrinsic motivators. *Review of Educational Research, 66* (1), 1–4.

Koskey, K. L., Karabenick, S. A., Woolley, M. E., Bonney, C. R., & Denver, B. V. (2010). Cognitive validity of students' self-reports of classroom mastery goal structure: What students are thinking and why it matters. *Contemporary Educational Psychology, 35* (4), 254–263.

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest, 7,* 77–124.

Lepper, M. R., Corpus, J. H., & Iyengar, S. S. (2005). Intrinsic and Extrinsic Motivational Orientations in the Classroom: Age Differences and Academic Correlates. *Journal of Educational Psychology, 97* (2), 184–196.

Lepper, M. R., Greene, D., & Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. *Journal of Personality and Social Psychology, 28,* 129–137.

Lepper, M. R., Keavney, M., & Drake, M. (1996). Intrinsic motivation and extrinsic rewards: A commentary on Cameron and Pierce's meta analysis. *Review of Educational Research, 66,* 5–32.

Lewin, K. (1938). *The conceptual representation and the measurement of psychological forces.* Durham, NJ: Prentice-Hall.

Linnenbrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading and Writing Quarterly, 19,* 119–137.

Linnenbrink-Garcia, L., Tyson, D. F., & Patall, E. A. (2008). When are achievement goal orientations beneficial for academic achievement?

A closer look at main effects and moderating factors. *International Review of Social Psychology, 21,* 19–58.

Maehr, M. L. (1976). Continuing motivation: An analysis of a seldom considered educational outcome. *Review of Educational Research, 46*(3), 443–462.

Maehr, M. L., & Anderman, E. M. (1993). Reinventing schools for early adolescents: Eemphasizing task goals. *Elementary School Journal, 93*(5), 593–610.

Maehr, M. L., & Midgley, C. (1996). *Transforming school cultures*. Boulder, CO: Westview Press.

Maehr, M. L., & Zusho, A. (2009). *Achievement goal theory: The past, present, and future.* In K. Wentzel & A. Wigfield, (Ed.), *Handbook of motivation at school* (pp. 77–104). New York, NY: Routledge.

McCroskey, J. C., Richmond, V. P., & Bennett, V. E. (2006). The relationships of student end-of-class motivation with teacher communication behaviors and instructional outcomes. *Communication Education, 55*(4), 403–414.

Meece, J., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement *Annual review of psychology* (Vol. 57, pp. 502–528). Stanford, CA: Annual Reviews.

Meece, J. L., & Miller, S. D. (2001). A longitudinal analysis of elementary school students' achievement goals in literacy activities. *Contemporary Educational Psychology, 26*(4), 454–480.

Middleton, M. J., & Midgley, C. (1997). Avoiding the demonstration of lack of ability. *Journal of Educational Psychology, 89*(4), 710–718.

Midgley, C. (Ed.). (2002). *Goals, goal structures, and patterns of adaptive learning*. Mahwah, NJ: Erlbaum.

Midgley, C., Kaplan, A., Middleton, M., Maehr, M. L., Urdan, T., Anderman, L. H., . . . Roeser, R. (1998). The development and validation of scales assessing students' achievement goal orientations. *Contemporary Educational Psychology, 23,* 113–131.

Midgley, C., & Urdan, T. (2001). Academic self-handicapping and performance goals: A further examination. *Contemporary Educational Psychology, 26,* 61–75.

Murayama, K., & Elliot, A. J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology, 101,* 432–444.

Nicholls, J. G. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard Univerity Press.

Nichols, S. L., & Berliner, D. C. (2005). *The inevitable corruption of indicators and educators through high-stakes testing*. Tempe, AZ: Education Policy Studies Laboratory.

Nichols, S. L., & Berliner, D. C. (2007). *Collateral damage: How high-stakes testing corrupts America's schools.* Cambridge, MA: Harvard Education Press.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66,* 543–578.

Pajares, F., & Schunk, D. H. (2001). Self-beliefs and school success: Self-efficacy, self-concept, and school achievement. In R. Riding & S. Rayner (Eds.), *Self-perception* (pp. 239–266). London, UK: Ablex.

Patrick, H., Anderman, L. H., Ryan, A. M., Edelin, K. C., & Midgley, C. (2001). Teachers' communication of goal orientations in four fifth-grade classrooms. *Elementary School Journal, 102*(1), 35–58.

Patrick, B. C., Skinner, E. A., & Connell, J. P. (1993). What motivates children's behavior and emotion? Joint effects of perceived control and autonomy in the academic domain. *Journal of Personality and Social Psychology, 65,* 781–791.

Pintrich, P. R. (2000a). The role of goal orientation in self-regulated learning. In M. Boedaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation: Theory, research and applications.* San Diego, CA: Academic.

Pintrich, P. R. (2000b). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology, 25,* 92–104.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82,* 33–40.

Plant, R. W., & Ryan, R. M. (1985). Intrinsic motivation and the effects of self-consciousness, self-awareness, and ego-involvement: An investigation of internally-controlling styles. *Journal of Personality, 53,* 435–449.

Putney, L. G., & Broughton, S. H. (2011). Developing Collective Classroom Efficacy: The Teacher's Role as Community Organizer. *Journal of Teacher Education, 62,* 93–105.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage.

Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist, 44,* 159–175.

Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology, 98,* 209–218.

Reeve, J., Jang, H., Carrell, D., Barch, J., & Jeon, S. (2004). Enhancing high school students' engagement by increasing their teachers' autonomy support. *Motivation and Emotion, 28,* 147–169.

Reyna, C. (2000). Lazy, dumb, or industrious: When stereotypes convey attribution information in the classroom. *Educational Psychology Review, 12,* 85–110.

Ryan, A. M., & Pintrich, P. R. (1997). "Should I ask for help?" The role of motivation and attitudes in adolescents' help seeking in math class. *Journal of Educational Psychology, 89,* 329–341.

Ryan, K. E., Ryan, A. M., Arbuthnot, K., & Samuels, M. (2007). Students' motivation for standardized math exams. *Educational Researcher, 36*(1), 5–13.

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality, 63,* 397–427.

Ryan, R. M., & Brown, K. W. (2005). Legislating competence: high-stakes testing policies and their relations with psychological theories and research. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 354–372). New York, NY: Guilford Press.

Ryan, R. M., & Deci, E. L. (2000a). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55,* 68–78.

Ryan, R. M., & Deci, E. L. (2000b). When rewards compete with nature: The undermining of intrinsic motivation and self-regulation. In C. Sansone & J. M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (pp. 13–54). San Diego, CA: Academic Press.

Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. In S. Fiske (Ed.), *Annual review of psychology* (Vol. 52, pp. 141–166). Palo Alto, CA: Annual Reviews.

Ryan, R. M., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: Does psychology need choice, self-determination, and will? *Journal of Personality, 74,* 1557–1586.

Ryan, R. M., & Deci, E. L. (2008). From ego-depletion to vitality: Theory and findings concerning the facilitation of energy available to the self. *Social and Personality Psychology Compass, 2,* 702–717.

Ryan, R. M., & Deci, E. L. (2009). Promoting self-determined school engagement: Motivation, learning, and well-being. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 171–195). New York, NY: Routledge.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26,* 207–231.

Schunk, D. H. (1995). Self-efficacy and education and instruction. In J. E. Maddux (Ed.), *Self-efficacy, adaptation, and adjustment: Theory, research, and application* (pp. 281–303). New York, NY: Plenum Press.

Schunk, D. H., & Pajares, F. (2005). Competence beliefs and academic functioning. In A. J. Elliott & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 85–104). New York, NY: Guilford Press.

Senko, C., Hulleman, C. S., & Harackiewicz, J. M. (2011). Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educational Psychologist, 46*(1), 26–47.

Shechter, O. G., Durik, A. M., Miyamoto, Y., & Harackiewicz, J. M. (2011). The role of utility value in achievement behavior: The importance of culture. *Personality and Social Psychology Bulletin, 37,* 303–317.

Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology, 42,* 70–83.

Stipek, D. J., & Kowalski, P. S. (1989). Learned helplessness in task-orienting versus performance-orienting testing conditions. *Journal of Educational Psychology, 81*(3), 384–391.

Swann, W. B., & Pittman, T. S. (1977). Initiating play activity of children: The moderating influence of verbal cues on intrinsic motivation. *Child Development, 48*(3), 1128–1132.

Tolman, E. C. (1932). *Purposive behavior in animals and men.* New York, NY: Appleton-Century-Crofts.

Tripathi, K. N., & Agarwal, A. (1988). Effect of reward contingency on intrinsic motivation. *Journal of General Psychology, 115*(3), 241–246.

Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M. H., Anderman, E. M., Kang, Y., & Patrick, H. (2002). The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology, 94*(1), 88–106.

Urdan, T., Midgley, C., & Anderman, E. (1998). The role of classroom goal structure in students' use of selfhandicapping strategies. *American Educational Research Journal, 35,* 101–122.

Urdan, T., Ryan, A. M., Anderman, E. M., & Gheen, M. (2002). Goals, goal structures, and avoidance behaviors. In C. Midgley (Ed.), *Goals, goal structures, and patterns of adaptive learning* (pp. 55–83). Mahwah, NJ: Erlbaum.

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research, 78,* 751–796.

Valencia, S. W., Hiebert, E. H., & Afflerbach, P. P. (1994). Realizing the possibilities of authentic assessment: Current trends and future issues. In S. W. Valencia, E. H. Hiebert & P. P. Afflerbach (Eds.), *Authentic reading assessment: Practices and possibilities*. Newark, DE: International Reading Association.

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic role of intrinsic goals and autonomy support. *Journal of Personality and Social Psychology, 87,* 246–260.

Vansteenkiste, M., Smeets, S., Soenens, B., Lens, W., Matos, L., & Deci, E. L. (2010). Autonomous and controlled regulation of performance-approach goals: Their relations to perfectionism and educational outcomes. *Motivation and Emotion, 34,* 333–353.

Weiner, B. (1985). An attribution theory of achievement motivation and emotion. *Psychological Review, 92,* 548–573.

Weiner, B. (1986). *An attributional theory of motivation and emotion*. New York, NY: Springer-Verlag.

Weiner, B. (1992). *Human motivation: Metaphors, theory, and research*. Newbury Park, CA: Sage.

Weiner, B. (1990). History of motivational research in education. *Journal of Educational Psychology, 82,* 616–622.

Wentzel, K. R., & Wigfield, A. (2007). Motivational interventions that work: Themes and remaining issues. *Special issue: Promoting motivation at school: Interventions that work, 42*(4), 261–271.

Wigfield, A., & Cambria, J. (2010a). Expectancy-value theory: retrospective and prospective. In T. Urdan & S. A. Karabenick (Eds.), *Advances in motivation and achievement: The next decade of research in motivation and achievement* (Vol. 16A, pp. 35–70). London, UK: Emerald.

Wigfield, A., & Cambria, J. (2010b). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review, 30,* 1–35.

Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review, 12*(3), 265–310.

Wigfield, A., & Eccles, J. S. (1994). Children's competence beliefs, achievement values, and general self-esteem: Change across elementary and middle school. *Journal of Early Adolescence, 14*(2), 107–138.

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68–81.

Wigfield, A., & Eccles, J. S. (2002). *Students' motivation during the middle school years.* San Diego, CA: Academic Press.

Wigfield, A., Tonks, S., & Lutz Klauda, S. (2009). Expectancy-value theory. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 55–75). New York, NY: Routledge.

Wigfield, A., & Wentzel, K. R. (2007). Introduction to motivation at school: Interventions that work. *Special issue: Promoting motivation at school: Interventions that work, 42*(4), 191–196.

Wolters, C. A. (2004). Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *Journal of Educational Psychology, 96,* 236–250.

Yeager, D. S. & Walton, G. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research, 81,* 267–301.

Zimmerman, B. J. (1994). Dimensions of academic self-regulation: A conceptual framework for education. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulation of learning and performance: Issues and educational applications* (pp. 3–21). Hillsdale, NJ: Erlbaum.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25,* 82–91.

Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31,* 845–862.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal, 29,* 663–676.

Zimmerman, B., J., & Kitsantas, A. (2005). Homework practices and academic achievement: The mediating role of self-efficacy and perceived responsibility beliefs. *Contemporary Educational Psychology, 30,* 397–417.

CHAPTER 6

Vygotsky and Sociocultural Approaches to Teaching and Learning

HOLBROOK MAHN AND VERA JOHN-STEINER

The increased recognition of the roles that cultural and social factors play in human development along with advances in neuroscience and cognition research present challenges to existing theories of learning and development (National Research Council [NRC], 1999). The NRC panel of prominent educators from various disciplines analyzed research on learning and developed an agenda for transforming education. This new agenda is especially important if education is going to meet the needs of all students, including those who are linguistically and culturally diverse. The NRC panel used the work of the Russian psychologist Lev Semyonovich Vygotsky as a foundation for their investigation. In this chapter we examine Vygotsky's work, which is becoming increasingly influential in shaping culturally relevant and dynamic theories of learning. In spite of increasing references to his work in the fields of education and educational psychology, his theoretical foundations and his methodological approach to the study of the mind remain relatively unknown to broader audiences.

We begin our discussion of Vygotsky's contributions to educational psychology with an overview of his life and work and then discuss ways in which his theoretical framework has influenced sociocultural approaches to learning and development. Vygotsky emphasized the critical role that individuals play in creating their sociocultural contexts and examined the ways in which individuals internalize interactions with the environment and other people. Human use and appropriation of socially created symbols were at the center of this investigation, which included examining language acquisition, sign-symbol use, and concept formation in relationship to learning and development. We use these concepts as the primary lenses for our examination of some salient issues in educational psychology and current educational reform efforts. To support our analyses we rely on an extensive and diverse literature reflecting what has been variously referred to as *sociocultural* or *cultural-historical* research.

Our focus in this chapter is to examine Vygotsky's use of the notion of social situations of development to analyze language, thought, and concept formation (Mahn, 2003; Vygotsky, 1998). Drawing on sociocultural studies based on Vygotsky's work, including our research in two, often overlapping fields—second language learning and literacy—we describe how Vygotsky's theoretical framework and methodological approach influenced our own studies. We conclude by examining how the sociocultural tradition can help us meet the challenge of providing effective education for all students, including those who are culturally and linguistically diverse and those with special needs. We start with an examination of the origins of the sociocultural tradition established by Vygotsky more than 80 years ago.

Sociocultural Research

The central shared theme in Vygotsky's work, and the family of theories based on that work, is the commitment to study the acquisition of human knowledge as a process of cognitive change and transformation. Sociocultural approaches use different disciplinary tools, including discourse analysis as developed by linguists, longitudinal methods familiar to developmental psychologists, and most frequently, qualitative methods of observation, participation, and documentation as practiced by ethnographers and cultural psychologists. This research does not fit easily into the methodological framework most familiar to readers of psychology. Our colleagues (Cole, 1996; Rogoff, 1990; Scribner & Cole, 1981; Wells, 1999) found that they could not adapt large-scale cross-sectional methods to their inquiries into psychological processes in culturally distinct contexts. Their research demanded an interdisciplinary methodological approach for which they chose Vygotsky's. Using his approach and theoretical framework, they examined the interrelationships of social and individual processes in the construction of knowledge and the ways in which culture shapes "apprenticeships of thinking" and diverse ways of knowing.

In their cross-cultural study of literacy among the Vai of Liberia, Scribner and Cole (1981) at first applied traditional experimental methods of research. However, those efforts failed because the researchers had not adequately identified the specific contexts and purposes for which that population used writing. The central point they make is that the acquisition of literacy is strongly influenced by cultural factors, something that was not considered in their experiments. They used experimental methods drawn from psychological research that focused on psychological factors. Scribner and Cole used ethnographic inquiries and the development of culturally relevant problem-solving tasks to encourage meaningful participation by their subjects. Scribner and Cole's resulting work, *The Psychology of Literacy*, has influenced many sociocultural theorists because their methodological approach provides complex documentation of existing conditions and subsequent change. Sociocultural approaches emphasize the examination of real-life problems in natural settings (frequently in classrooms) and the analysis of ways in which people appropriate new learning strategies, jointly develop artifacts, and practice newly acquired competencies, using their developing understandings of the concepts introduced in school.

Sociocultural Approaches and Educational Psychology

In contrast to dominant psychological theorists of his day (such as Piaget and Freud) who generally ignored the role of history and culture, and, consequently, based their analysis of thinking, learning, and teaching on universal models of human nature, Vygotsky's sociocultural framework supports pedagogical and research methods that honor human diversity and emphasize the influence that social and historical contexts have on teaching and learning. The experiences of sociocultural researchers using Vygotsky's theoretical framework and methodological approach in their ethnographic investigations have contributed to a view of teaching and learning that places culture, context, and system at the center of inquiry. Our purpose, then, is to clarify the concepts that guide sociocultural interdisciplinary research and its relevance for educational psychology. We realize that the framework we describe is not easy to convey, as it relies on philosophical assumptions and psychological ideas that vary from those commonly associated with educational psychology. What, then, is its relevance to this volume? A common ground, we believe, is a shared commitment to the improvement of all children's opportunities to learn in rapidly changing, complex societies. Sociocultural researchers have a contribution to make to this objective, as much of their work—while situated at the interface of a number of disciplines—is aimed at educational reform. This contribution is especially important today with the increased presence of linguistically and culturally diverse learners and the increased use of standardized testing to guide educational policy. Vygotsky's theoretical framework, with its emphasis on language, culture, social interaction, context, and meaning as central to learning and development, is particularly relevant to teaching diverse learners and understanding how children most effectively learn. Our intent is to describe this broad framework and then apply it to a narrower focus—the obstacles learners face when acquiring literacy in a second language.

A Vygotskian Framework

In developing his theoretical framework, Vygotsky studied and critiqued contemporary psychologists' theories of the mind and focused on the ways in which they addressed the development of higher psychological functions. Vygotsky's theoretical approach stressed the complex relationships between the cognitive functions that we share with much of the natural world and those mental functions that are distinctively human. He emphasized the dialectical relationship between individual and social processes and viewed the different psychological functions as part of a dynamic system. His study of the unification of thinking and language processes in *verbal thinking* provided the foundation for his examination of the role of concept formation in creating a system of meaning (Vygotsky, 1987). Key to this examination was his methodological approach that relied heavily on the dialectical approach developed by Marx and Engels in the *German Ideology* (1976) and elaborated in its application by Engels (1963). At the center of this approach, which is described in more detail later, is the concept of *systems*—that all matter exists in complex, evolving, interconnected systems. Vygotsky and his associates, particularly Luria developed an analytic approach that looked at mental functions and processes as interrelated systems, what has come to be known as *functional systems analysis*. Alexander Luria (1973, 1979; Cole, Levitin, & Luria, 2006) further developed the concept of a dynamic system of functions in his neurological research on the ways in which brain trauma affects cognitive processing. The two men worked closely together and co-authored some early chapters, which were influential in Luria's later works (i.e., *The Working Brain*, 1973; *Cognitive Development, Its Cultural and Social Foundations*, 1976) and to Vygotsky's development of his sociocultural theoretical framework. After Vygotsky's early death, Luria assumed the major responsibility to keep his legacy alive.

Vygotsky's analysis of the role of systems in language and literacy acquisition and in concept formation provides insights into *synthesis* and *transformation* in learning and development. This synthesis is hard to conceptualize because we are used to methodological individualism—a single focus on behavior in isolation from culturally constituted forms of knowing, productive social interaction, and dynamic contexts. In contrast, the weaving together of individual and social processes through the use of mediational tools, such as language and other symbol systems, and the documentation of their synthesis and transformation is crucial for understanding sociocultural theories and, in particular, the role that they ascribe to interactions in social contexts. In educational psychology, where the relationship between students and teachers has been of vital concern, the emphasis throughout the 20th century has been on the developmental unfolding of the self-contained learner. In contrast, Vygotsky stressed the important role of the interaction between the individual and the social in the teaching/learning process. Vygotsky used *social* in the broadest sense, including everything cultural: "Culture is both a product of social life and of the social activity of man and for this reason, the very formulation of the problem of cultural development of behavior already leads us directly to the social plane of development" (Vygotsky, 1997a, p. 106). His emphasis on the interdependence of individual and social processes is one reason why his work is so important today.

The transformation of social processes into individual ones is central in sociocultural theory and contributes to its interdisciplinary nature. Within a framework based on Vygotsky's theory, it is difficult to maintain the traditional distinctions between individual and social processes, between educational and developmental psychology, between teaching and learning, and between quantitative and qualitative methods. Sociocultural approaches thus draw on a variety of disciplines, including linguistics, anthropology, psychology, philosophy, and education. Their contemporary influence is most noticeable in interdisciplinary fields such as sociolinguistics and cultural psychology.

The most important shared direction between contemporary developments in educational psychology and sociocultural approaches is that of distributed cognition. This approach is illustrated by the works of Pea (2000), and Hutchins (1995), who writes, "The emphasis on finding and describing 'knowledge structures' that are somewhere 'inside' the individual encourages us to overlook the fact that human cognition is always situated in a complex sociocultural world and cannot be unaffected by it" (p. xiii). Other researchers who have built on Vygotsky's legacy have addressed psychological topics such as memory (Leontiev, 1959/1981) and problem solving (Panofsky, John-Steiner, & Blackwell, 1990; van Oers, 1999). Susan Gelman (2009) illustrates a shift among traditional researchers studying children's learning towards a strong emphasis upon the role of social interaction in children's acquisition of productive cognitive strategies. Interdisciplinary research based on Vygotsky is also prevalent in investigations of teaching and learning processes (Moll, 1990; Tharp & Gallimore, 1988; Wells, 1999; Wells & Claxton, 2002). Additionally, sociocultural researchers have turned to brain research as a way to understand their students' learning processes and to engage them in meaningful activities both in and out of the classroom (Fischer & Immordino-Yang, 2008). In recent years, mathematical development and education have increasingly been addressed through collaborations that reflect a Vygotskian perspective, (Davydov, 1988; Hersch & John-Steiner, 2011; Schmittau, 1993). Research in a broad number of different fields also rely on Vygotsky's theory and methods, including the study of: literacy (John-Steiner, Panofsky, & Smith, 1994; Lee & Smagorinsky, 2000); second language acquisition (Lantolf, 2000; Lantolf & Poehner, 2008; Lantolf & Thorne, 2006); mathematics (Schmittau, 2011); second language literacy (Mahn, 2008); and creativity (Connery, John-Steiner, & Marjanovic-Shane, 2010; John-Steiner, 2000; Kim, 2006). Although some of Vygotsky's concepts, most notably the zone of proximal development—often referred to as the most cited, least understood concept in education—have been widely described in textbooks, the full range of his contributions has yet to be explored and applied. For further overviews of Vygotsky's work, see Chaiklin, 2001; Daniels, Cole, & Wertsch, 2007; Gredler & Shields, 2008; John-Steiner & Mahn, 1996; Kozulin, 1990; Newman & Holzman, 1993; Van der Veer & Valsiner, 1991; Wertsch, 1985a.

VYGOTSKY AND SOCIOCULTURAL THEORY

> How is Vygotsky to be understood? As a hidden treasure who can now be revealed to the world? As an historical figure; part icon, part relic? As the construction of a historical figure used for contemporary purposes to ventriloquate contemporary arguments? As a lost contemporary, speaking to us across time? There is no exclusively correct choice among these alternatives, he is all of these. (Glick, 1997, p. v)

There was little biographical material accompanying the first works of Vygotsky translated into English. James Wertsch (1985b), a sociocultural theorist who played an instrumental role in helping make Vygotsky's ideas available in English, interviewed people who knew Vygotsky to provide biographical material. Recently, more biographical material has become available from Vygotsky's daughter, Gita Vygotskaya (1999; Vygodskaya, & Lifanova, 1999a, 1999b, 1999c).

Historical and Biographical Background

Lev Semyonovich Vygotsky was born in 1896 in the small Russian town of Orsha and was raised in Gomel in Belorussia. His middle-class parents were able to afford private tutoring at a time when most Jewish students were excluded from regular public schooling. His mother's influence was profound, as she introduced Vygotsky to languages, literature, and the pleasures of daily conversation. In 1913, he was fortunate to be admitted, as a result of a lottery, to Moscow University, where he enrolled in the medical school. After a month he transferred to the law school, from which he earned a law degree in 1917. In 1914, he also enrolled in a free university, from which he also graduated in 1917 with majors in history and philosophy (Blanck, 1990). Literature remained a lifelong passion and furnished Vygotsky with important psychological insights. He was an avid reader of the work of European scholars, in particular, Spinoza, whose work was central to his theory of emotions. Vygotsky studied and translated many works of the leading psychological thinkers of his time (including Freud, Buhler, James, Piaget, and Pavlov). After graduating from the universities, Vygotsky returned to Gomel, where he spent the next 7 years teaching an array of courses on literature and Russian, as well as logic, psychology, aesthetics, art history, and theater while continuing his intellectual pursuits (Blanck, 1990). His interest in teaching/learning and in psychology resulted in one of his earliest books, *Pedagogical Psychology*, published in 1926 (the American edition of this volume was retitled *Educational Psychology*, Vygotsky, 1926/1997).

The aftermath of the Russian revolution of 1917 provided new opportunities for Vygotsky. He was able to teach and travel, to present papers at psychological congresses, and to begin to address the challenge of the nature of consciousness using Marx and Engels' methodological approach. In 1924, he spoke at the Second All-Russian Psychoneurological Congress in Leningrad. His presentation there was widely acclaimed as brilliant and resulted in his joining the Institute of Experimental Psychological in Moscow, where he and his wife lived in the basement. A year later, Vygotsky was supposed to defend his dissertation titled *The Psychology of Art*, but he was bedridden with a serious bout of tuberculosis, the disease that eventually killed him in 1934. Once in Moscow in 1924, Vygotsky, surrounded with young colleagues and students, devoted himself to the construction of a new psychology, one adequate to study human consciousness.

During the turbulent years spanning from the 1917 revolution through the Civil War in the Soviet Union to Stalin's purges in the 1930s, many psychologists took part in rethinking basic issues, such as "What is human nature?" or "How do we define consciousness?" Vygotsky sought to apply Marx's dialectical method to the study of the mind rather than patch together quotations from Marx, as became the practice after Stalin took power in 1924. Vygotsky's creative, nondogmatic approach ran afoul of the ruling Stalinist bureaucracy and his work was banned in 1936, 2 years after his death, when the political climate became so repressive that the discipline of psychology was temporarily done away with.

In contrast to the Soviet bureaucracy's claim that Vygotsky was not "Marxist," Luria (1979), one of Vygotsky's closest collaborators, wrote, "Vygotsky was the leading theoretician among us" (p. 43). After quoting a passage from Marx on the nature of human consciousness, Luria wrote, "This kind of general statement was not enough, of course, to provide a detailed set of procedures for creating an experimental psychology of higher psychological functions. But in Vygotsky's hands Marx's methods of analysis did serve a vital role in shaping our course" (p. 43).

One of Vygotsky's goals was "to develop concrete ways of dealing with some of the massive practical problems confronting the USSR—above all the psychology of education and remediation" (Wertsch, 1985a, p. 11). This was a huge undertaking in an underdeveloped, poor country that had borne the brunt of World War I in terms of loss of life and economic devastation, and then had gone through a profound social revolution and a prolonged civil war. The extraordinary challenge of developing literacy in a society where the population over the age of 9 years was largely illiterate made it difficult to use traditional approaches.

In their travels throughout the Soviet Union, Vygotsky and his collaborators were able to assess the population's needs and to set up laboratories and special education programs for children who had suffered trauma. This work contributed to Vygotsky's recognition of the crisis in psychology (1997b) and led him to develop a new methodological approach for psychological research that included formative experiments rather than just laboratory experiments. "The central problems of human existence as it is experienced in school, at work, or in the clinic all served as the contexts within which Vygotsky struggled to formulate a new kind of psychology" (Luria, 1979, pp. 52–53).

The Search for Method

Vygotsky's approach revealed the need for psychology to develop a new methodology that surmounted the weaknesses of both behaviorism and subjective psychology. Vygotsky (1978) wrote, "The search for method becomes one of the most important problems of the entire enterprise of understanding the uniquely human forms of psychological activity. In this case, the method is simultaneously prerequisite and product, the tool and the result of the study" (p. 65). In *The Historical Meaning of the Crisis in Psychology: A Methodological Investigation* (1997b), Vygotsky described his search for a methodological approach appropriate to the study of the human psyche, which he viewed as a unification of the brain and mind. He reviewed the dominant theories in psychology and drew on explanations that accurately described aspects of human mental processes that had been measured empirically and justified theoretically. He used the errors that he found in these theories as a starting point for further investigations—errors that accrued from an uncritical application of methodology inherited from the natural sciences. This methodology, based on formal logic, posits a static universe in which immutable laws determine categories with impenetrable boundaries. It dichotomizes reality and creates binary contradictions: mind versus matter, nature versus culture, individual versus social, internal versus external, and process versus product. Reductionist approaches "depend on the separation of natural processes into isolable parts for individual study. They have provided a rich repertoire of information about the world, but they systematically ignore the aspects of reality that involve relations between the separated processes" (Bidell, 1988, p. 330). Rather than isolating phenomena, Vygotsky studied the mind by examining its origins and development as a system within a system of systems, including biological, emotional, cultural, and social systems. Central to his study was the analysis of the elemental human functions, those with which a child is born, and the higher psychological processes that have the unification of thinking and language processes as their foundation.

Vygotsky (1997b) also pointed out the errors of Stalin and those influenced by him, as they tried to create a "Marxist" approach to every science including psychology by pulling quotations out of context from Marx and Engels' works and applying them in contexts for which they were not appropriate. Vygotsky contrasted that approach to one based on Marx and Engels' work as whole, particularly the way that they used dialectics as an integral component of their approach. Different assessments of the degree to which Vygotsky relied on Marx and Engels' dialectical approach have led to a wide variation in interpretations and understandings of his work, particularly his analysis of the way that individuals form concepts through the social-interactive use of language to construct systems of meaning. Because there are so many different uses and meanings of *dialectics*, it is important to be clear on the way that this term is used to discuss Vygotsky's approach.

> Dialectics is the logic of movement, of evolution, of change. Reality is too full of contradictions, too elusive, too manifold, too mutable to be snared in any single form or formula or set of formulas. Each particular phase of reality has its own laws and its own peculiar categories and constellation of categories which are interwoven with those it shares with other phases of reality. These laws and categories have to be discovered by direct investigation of the concrete whole; they cannot be excogitated by mind alone before the material reality is analyzed. (Novack, 1969, p. 66)

Vygotsky's goal was to discover and describe the laws and categories for the development of the mind and human consciousness. Using a historical approach to analyze the development of the mind, he looked at the development of social systems and situated the individual in concrete contexts in which learning and development occur, and thus paid close attention to the individual's particular *social situation of development*.

When Vygotsky began his investigation of higher psychological processes, he clearly had assimilated Marx and Engels's dialectical method and their analysis of the formation and the development of human society and used this understanding as a foundation for his own work. Marx and Engels studied the origins and development of human social formations and discovered the laws and categories that explained the forces behind them. They used these laws and categories to develop a theoretical and methodological approach called *historical materialism*. Vygotsky clearly explained the distinction between Marx and Engels' use of a dialectical approach to analyze the development of human social formations and his own application of the dialectical approach to the study of the mind/psyche. Vygotsky, in *Crisis*, outlined the challenge for psychology—to come up with a theoretical and methodological approach to the study of the human psyche. In the same way that Marx and Engels developed *historical materialism* to study human social formations, Vygotsky aimed to develop *psychological materialism* to study the human psyche—to apply the abstract concepts of dialectical materialism to the study of human consciousness in relationship to current research.

Vygotsky's Methodological Approach

Vygotsky's application of the dialectical method focused on analyzing how language and other symbol systems affect the origins and development of higher mental functions as individuals learn and develop and create their systems of meaning. Vygotsky used the concept of *meaning* to analyze the relationship between language and thinking processes, and also looked at the ways in which other culturally constituted symbol systems such as mathematics and writing contribute to the development of human cognition. This approach influenced sociocultural reseachers' use of ethnographic research methods as described further on. The research conducted by Vygotsky, his collaborators, and his students was given limited attention in the West until the past few decades, most likely due to the distinct difference of his methodological approach. Soviet scholars in the 1920s and 1930s did not use sophisticated statistics and carefully chosen experimental controls; instead, their focus was on the short- and long-term consequences of theoretically motivated interventions. This approach centered on provoking rather than controlling change. "Any psychological process, whether the development of thought or voluntary behavior, is a process undergoing changes right before one's eyes" (Vygotsky, 1978, p. 61). Elsewhere, we have written more extensively about Vygotsky's use of his theoretical framework and methodological approach to examine the development of psychological processes (John-Steiner & Souberman, 1978; Mahn, 1999, 2010); here, we examine his use of *genetic analysis*—the study of phenomena in their origins and their development. Although Vygotsky's use of genetic analysis is widely known, his application of it to analyze the system of meaning has not received much attention, even though it constitutes the core of his scientific analysis and remains his most significant contribution to the study of the human psyche.

Vygotsky examined the origins and evolution of phenomena, such as higher mental functions and psychological processes/systems, as dynamic, contextual, and complex entities in a constant state of change. His dialectical approach had the following as central tenets: (a) that phenomena should be examined as a part of a developmental process starting with their origins; (b) that change occurs through qualitative transformations, not in a linear, evolutionary progression; and (c) that these transformations take place through the unification of contradictory, distinct processes. He used dialectics to examine the processes that brought the mind into existence and to study its historical development. "*To study something historically means to study it in the process of change;* that is the dialectical method's basic demand" (Vygotsky, 1978, pp. 64–65). Vygotsky saw change in mental functioning not as the result of a linear process, but rather as the result of quantitative changes leading to qualitative transformations. In these transformations, formerly distinct processes became unified. Following Marx and Engels, Vygotsky grounded his approach in the material world, starting his analysis with the changes that occurred when humans began to control and use nature to meet their needs. Vygotsky's collaborator, Alexander Luria, described the need to find "the way natural processes such as physical maturation and sensory mechanisms become intertwined with culturally determined processes to produce the psychological functions of adults. We needed to step outside the organism to discover the sources of specifically human forms of psychological activity" (Luria, 1979, p. 43). The *stepping outside of the organism*, described here by Luria, has been instrumental to sociocultural researchers who use ethnographic methods when studying other cultures.

Ethnographic Research Methods

For example, sociocultural reseachers have used ethnography to inquiry into the apprenticeships of thinking in Guatemala (Rogoff, 1990, 2003) and the study of literacy in Liberia (Cole, 1996; Scribner & Cole, 1981). John-Steiner used this method in her work with Navajo children when she found that traditional vocabulary tests were inappropriate to assess the language development of these bilingual children. She adopted the more culturally appropriate methods of observation and documentation to identify the learning activities in which traditionally raised Navajo children participated and designed new ways (e.g., story retelling) to evaluate their language learning (John-Steiner & Osterreich, 1975). Her work among Native American populations played an important role in the development of her theory of cognitive pluralism (John-Steiner, 1991, 1995).

Cognitive Pluralism

Through her observations in Native American schools, John-Steiner noted that Navajo and Pueblo children conveyed knowledge not only through language, but also by dramatic play, drawing, and reenacting their experiences in spatial and kinesthetic ways. This caused a shift in her approach and led to the development of a pluralistic rather than a monistic theory of semiotic mediation based on her studies of these learners. Semiotic mediation describes the role played by language and other symbols to mediate the perception and understanding of the objective world. "Semiotic activity . . . is *the activity of relating a sign and its meaning, including the use of signs, the activity of investigating the relationship between sign and meaning, as well as improving the existing relationship between sign (or sign system) and meaning (or meaning system)*" (van Oers, 2011, p. 1).

The concept of cognitive pluralism provided John-Steiner with a new lens to examine the impact of external activities on the acquisition and representation of knowledge in these two societies. She focused on the important roles of ecology, history, culture, and family organization in the patterning of events and experience that create knowledge (John-Steiner, 1995). In a culture where linguistic varieties of intelligence are dominant in the sharing of knowledge and information, verbal intelligence is likely to be widespread. But in cultural contexts where visual symbols predominate, as is the case in many Southwestern communities, internal representations of knowledge reflect visual symbols and tools. John-Steiner's interpretation of the multiplicity of ways in which we represent knowledge does not have the strong biological base of Gardner's (1983) theory of multiple intelligences but shares the emphasis on the diversity of knowledge acquisition and representation. In *Notebooks of the Mind*, she further illustrates the concept of cognitive pluralism by examining the varied ways in which experienced thinkers make and represent meaning through the use of words, drawings, musical notes, and scientific diagrams in their planning notes (John-Steiner, 1997). She cites the work of Charles Darwin, who relied on tree diagrams in his notebooks to capture his developing evolutionary theories in a condensed visual form.

The Role of Culture

Cross-cultural studies, such as Cole, Gay, Glick, and Sharp's work (1971) on adult memory, illustrate the relevance of cognitive pluralism and contribute to our understanding of the impact of culture on cognition. In their work among the Kpelle and the Vai in Liberia, Cole and his collaborators found that categories organized in a narrative form were remembered very well by native participants whereas their performance on standard (Western) tasks compared poorly with that of North American and European participants. In *Cultural Psychology*, Cole (1996) proposed that the focus of difference among distinct groups is located in the ways they organize the activity of everyday life. Sociocultural researchers have increasingly made such activity a focus for study Wertsch (1991).

For Vygotsky, the key was the way that social activity became internalized and helped the development of the language and thinking processes so fundamental to higher psychological processes, to human consciousness. Sociocultural studies, such as those mentioned above, explore the role played by culture in this shaping of both thinking and context. They illustrate Vygotsky's analyses of both the growth and change of higher psychological processes through cultural development and of the relationship between the elementary and the higher mental functions.

VYGOTSKY'S ANALYSIS OF ELEMENTARY AND HIGHER MENTAL FUNCTIONS

When Vygotsky developed his analysis of higher mental functions/psychological processes, psychology was divided into two dominant and distinct camps: one that relied on stimulus-response to explain human behavior and the other that relied on introspection as an alternative to empirical research. Rather than trying to reconcile these two disparate approaches, Vygotsky argued that a whole new approach was necessary to study the mind—one that critically examined psychology's origins in the natural sciences. In developing his new approach, Vygotsky focused on the origins and the development of the higher mental processes. He distinguished between mental functions that reside in biology—the reflexes of the animal kingdom (involuntary attention, mechanical memory, flight)—and those that result from cultural development—voluntary attention, logical memory, and formation of concepts.

Vygotsky studied prevailing psychological explanations of the development of higher mental functions/processes and found that they addressed the origins, development, and purposes of the elementary mental functions but not the roles of language, human society, and culture in the genesis and development of the higher mental functions. His analysis of Freud was particularly intriguing in this regard. While he accepted the subconscious, Vygotsky commented "the subconscious is not separated from consciousness by an impassable wall" (quoted in Yaroshevsky, 1989, p. 169). Vygotsky (1997a) felt that clinical studies that isolated features or functions of human behavior resulted in "an enormous mosaic of mental life . . . comprised of separate pieces of experience, a grandiose atomistic picture of the dismembered human mind" (p. 4). Vygotsky's critique of this picture became the starting place for his research.

Functional Systems Analysis

To study higher mental functions, Vygotsky developed a *functional systems approach*, which emphasized the importance of examining the interrelationships of mental processes within psychological systems. He analyzed cognitive change as both within and between individuals. In a previous paper we defined functional systems as "dynamic psychological systems in which diverse internal and external processes are coordinated and integrated" (John-Steiner & Mahn, 1996, p. 194). A functional systems approach captures change and provides a means for understanding and explaining qualitative transformations in mental functions. In their analysis of psychological processes as functional systems formed in the course of development, Vygotsky and Luria examined the ways biological, social, emotional, and educational experiences of learners contribute to and function within dynamic teaching/learning contexts.

Research Applications

In *The Construction Zone*, Newman, Griffin, and Cole (1989) described their application of Vygotsky's and Luria's functional systems analysis to education. They conceptualized a functional system as including "biological, culturally variable, and socially instantiated mechanisms in variable relations to the invariant tasks that we investigate" (p. 72). *Invariant tasks* refers to specific memory and concept sorting tasks used in clinical evaluations and experimental studies in which participants are provided with mediating tools. This approach was also used in Vygotsky's well-known block test, which consisted of 22 wooden blocks of varying sizes, shapes, and colors, with nonsense syllables on the bottom of the blocks serving as guides to systematic sorting. These syllables are mediating tools because they help the subjects to construct consistent clusters of blocks. As children acquire increasingly more sophisticated ways of sorting blocks, their progress *reveals* changes and reorganizations in their functional systems and not just the simple addition of new strategies. (Later we describe work done by Pauline Towsey replicating Vygotsky's and Sakharov's block test.)

In his research with patients with frontal lobe injuries, Luria (1973) found that these injuries limited the patients' use of external devices so that they needed assistance in using semiotic means. He found that patients improved when clinicians provided new tools and mechanisms to solve memory and sorting tasks. Wertsch (1991) described the *semiotic mediation* between individuals and cultural or mediational tools:

> The incorporation of mediational means does not simply facilitate actions that could have occurred without them; instead as Vygotsky (1981, p. 137) noted, "by being included in the process of behavior, the psychological tool alters the entire flow and structure of mental functions. It does this by determining the structure of a new instrumental act, just as a technical tool alters the process of a natural adaptation by determining the form of labor operations." (pp. 32–33)

Vygotsky (1997a) warned that he was using the analogy between physical tools and psychological tools only in a formal, logical sense, and that it was not applicable in describing the genetic, functional, or structural development of the mind as a system in systems. Elsewhere, Wertsch (1985a) described multiplication as an example of mediation because of the ways in which semiotic rules provide a system, spatially arranged, to assist the individual who is engaged in mediated action.

Cultural Tools

Vygotsky examined the ways in which the use of symbolic tools and artifacts contributed to the development of systems of meaning and also revealed information about the processes through which humans think, reason, and form concepts. This is represented in the way sociocultural researchers examine the use of mediational tools such as talk or charts in the evolution of cognitive constructs. These external tools reflect experiences of learners from previous generations and are crystallized in “cultural tools,” which children have to master to become members of the human community (Stetsenko & Arievitch, 2002).

Vygotskian approaches, as described above, are becoming more popular in mathematics and literacy education. In their research of high school mathematics, Tchoshanov and Fuentes (2001) explored the role of multiple representations and symbolic artifacts (numerical, visual, computer graphic symbols, and discourse). These multiple semiotic means constitute a functional system that, if used flexibly by different learners, effectively contributes to the development of abstract mathematical thinking.

In studies of literacy, a functional systems analysis highlights the integration of the semantic, syntactic, and pragmatic systems in reading and focuses on ways learners from diverse backgrounds use their past learning strategies to acquire new knowledge. In a study of Hmong women, Collignon (1994) illustrates a synthesis between traditional sewing practices and English as a Second Language (ESL) instruction. The method by which sewing was taught to young Hmong women became their preferred method for learning English as a second language. Here, developmental change goes beyond the addition of a new skill as represented in many traditional learning theories; it implies synthesis and transformation through the weaving together of individual and social processes.

INDIVIDUAL AND SOCIAL PROCESSES IN LEARNING

One of Vygotsky’s major contributions to educational psychology—his analysis of the interweaving of individual and social processes—is also a major theme of a volume that reports on a 2-year project evaluating new developments in the science of learning (NRC, 1999). Two central aspects of learning presented in the findings of this project coincide with essential concepts of Vygotsky’s analysis. First is the role of social interaction and culture in teaching/learning: “Work in social psychology, cognitive psychology, and anthropology is making clear that all learning takes place in settings that have particular sets of cultural and social norms and expectations and that these settings influence learning and transfer in powerful ways” (NRC, 1999, p. 4). The second aspect is the functional systems approach: “Neuroscience is beginning to provide evidence for many principles of learning that have emerged from laboratory research, and it is showing how learning changes the physical structure of the brain and, with it, the functional organization of the brain” (NRC, 1999, p. 4). The analysis presented in this report on the science of learning also supports Vygotsky’s position that learning leads development.

Learning and Development

“Learning and development are interrelated from the child’s very first day of life,” Vygotsky (1978, p. 84) wrote. In comparing his own approach with that of some of his influential contemporaries, including Thorndike, Koffka, and Piaget, Vygotsky argued against using maturation as the central explanatory principle of development. He also differed on the relationship between development and social processes. “In contrast to Piaget, we believe that development proceeds not toward socialization, but toward converting social relations into mental functions” (Vygotsky, 1997a, p. 106). He further opposed approaches that reduced learning to the acquisition of skills. In contrast to traditional “banking” concepts of learning, Vygotsky (1926/1997) introduced a different metaphor:

> Though the teacher is powerless to produce immediate effects on the student, he’s all-powerful in producing direct effects on him through the social environment. The social environment is the true lever of the educational process, and the teacher’s overall role is reduced to adjusting this lever. Just as a gardener would be acting foolishly if he were to affect the growth of a plant by directly tugging at its roots with his hands from underneath the plant, so the teacher is in contradiction with the essential nature of education if he bends all his efforts at directly influencing the student. But the gardener affects the germination of his flowers by increasing the temperature, regulating the moisture, varying the relative position of neighboring plants, and selecting and mixing soils and fertilizers. Once again, indirectly by making appropriate changes to the environment. Thus, the teacher educates the student by varying the environment. (p. 49)

This metaphor describes a process of scaffolded learning (Wood, Bruner, & Ross, 1976) in which someone who is more expert creates the foundation for a child’s *zone of proximal development*. Vygotsky (1978) used this concept, for which he is best known, to differentiate between two levels of development: The first, the actual level of development, is achieved by independent problem solving. This is the level of development of a child's mental functions that has been established as a result of certain already-completed developmental cycles and is measured when students are given tests to complete on their own. The second level, designated by Vygotsky as the potential level of development, describes what a child or student can accomplish with the guidance or collaboration of an adult or more capable peer. Through the concept of the zone of proximal development, learning processes are analyzed by looking at their dynamic development and by recognizing the immediate needs for students' development. The issue, however, is not resolved once we find the actual level of development. "It is equally important to determine the upper threshold of instruction. Productive instruction can occur only within the limits of these two thresholds of instruction. *The teacher must orient his work not on yesterday's development in the child but on tomorrow's*" (Vygotsky, 1987, p. 211).

Many researchers, who base their work on Vygotsky's theory, invoke his concept of the zone of proximal development (ZPD) so it is impossible to give a comprehensive overview here. Mahn and Reierson (2013) and Lantolf and Beckett (2009) provide overviews of how the ZPD has been used in studies on second language acquisition and learning. Similarily, Rowlands (2003) analyzes the way that the concept of the ZPD has been used in mathematics education. Aram and Levin (2010) look at how the ZPD can be used to examine the support that children receive at home helping them in their early experiences with writing. Antonacci (2000) uses this concept to examine beginning readers. Bodrova and Leong (1998, 2006) rely heavily on the ZPD in their examination of emergent literacy in early childhood.

Vygotsky also used the concept of the zone of proximal development to describe the gap between children's everyday (spontaneous) concepts and academic/scientific concepts. Drawing on Vygotsky's work, especially as interpreted by Davydov (1990), Jean Schmittau (2004, 2005, 2011) examines this aspect of the ZPD in the field of mathematics. Even though Vygotsky developed this concept late in his life and did not have the opportunity to elaborate it fully, it flowed from and was an aspect of his whole theoretical approach to teaching and learning.

Teaching/Learning

Vygotsky's work is characterized by its emphasis on the dialectical relationship between teaching and learning. The Russian word *obuchenie,* which means teaching/learning, speaks of a unified process, rather than the paradigmatic separation of the two: "The Russian word obuchenie does not admit to a direct English translation. It means both teaching and learning, both sides of the two-way process, and is therefore well suited to a dialectical view of a phenomenon made up of mutually interpenetrating opposites" (Sutton, 1980, pp. 169–170). Among sociocultural theorists, teaching/learning is represented as a joint endeavor that encompasses learners, teachers, peers, and the use of socially constructed artifacts, including semiotic means, particularly language:

> The importance of material artifacts for the development of culture is by now well understood; the invention of the flint knife and later of the wheel are recognized to have radically changed the possibilities for action of the prehistoric societies which invented them. . . . In more recent times, the same sort of significance is attributed to the invention of the printing press, powered flying machines and the microchip. But Vygotsky's great contribution was to recognize that an even greater effect resulted from the development of semiotic tools based on signs, of which the most powerful and versatile is speech. For not only does speech function as a tool that mediates social action, it also provides one of the chief means—in what Vygotsky (1987) called "inner speech"—of mediating the individual mental activities of remembering, thinking, and reasoning. (Wells, 1999, p. 136)

In addition to his emphasis on socially constructed artifacts, Vygotsky also stressed the role of the environment as reflected in the gardening metaphor just quoted. In conceiving of environment more broadly than just the physical context, Vygotsky attributed an important role to individuals' contributions to the environment, including their emotional appropriation of interactions taking place within specific contexts.

Affective Factors

In constructing a general trajectory of development and clarifying the role of context, Vygotsky (1994) underscored the specificity of human experience through his notion of *perezhivanie* (plural *perezhivanija*) which captures "how a child becomes aware of, interprets, [and] emotionally relates to a certain event" (p. 341); "the essential factors which explain the influence of environment on the psychological development of children and on the development of their conscious personalities, are made up of their emotional experiences [*perezhivanija*]" (p. 339). Vygotsky developed the concept of *perezhivanie* to describe an important component of the dynamic complex system that constitutes context—what the child or student brings to and appropriates from interactions in a specific context. The translators of the article, "The Problem of the Environment," in which Vygotsky explained his notion of *perezhivanie*, note that the "Russian term serves to express the idea that one and the same objective situation may be interpreted, perceived, experienced or lived through by different children in different ways" (Van der Veer & Valsiner, 1994, p. 354). This notion, often left out of discussions of context, was a central consideration for Vygotsky.

Sociocultural Approaches to Context

The word "context" is open to multiple interpretations. The etymology of "context" from the Latin *contextera* (to weave together) is closely related to that of "text," the Latin *textum* (that which is woven, a fabric; Skeat, 1995). This explanation of the word helps capture two central elements in Vygotsky's theoretical framework: the dialectical weaving together of individual and social processes in learning and development, and the recognition that human activity takes place in a social and historical context and is shaped by, and helps shape, that context. Vygotsky viewed humans as the creators and the creations of context and felt that their activity reflected the specificity of their lives rather than ahistorical universal principles. In emphasizing the active role of learners, we see them, along with other sociocultural theorists (i.e., Kozulin, Gindis, Ageyev, & Miller, 2003; Moll, 1990; Rogoff, 1990; Tharp & Gallimore, 1988; Wells & Claxton, 2002), as members of learning communities. Such an approach helps synthesize a frequently dichotomized view of teaching and learning in education where the works of learning theorists are isolated from the findings of developmentalists.

In studying learning communities, sociocultural theorists have made the cultural and social aspects of context a focus for their studies (Cole, 1996; Lave, 1988; Lave & Wenger, 1991; Rogoff, 1990, 2003; Wenger, 2011). In *Teaching Transformed*, Tharp, Estrada, Dalton, and Yamuchi (2000) highlight the educational importance of context: "Effective teaching requires that teachers seek out and include the contexts of students' experiences and their local communities' points of view and situate new academic learning in that context" (p. 26). Tharp et al. illustrate a growing consensus among educational reformers of the significance of contextualized activities. They provide an example of such a contextualized activity, which consists of sixth graders collecting height and weight data in the children's home communities and discussing the best way to represent the data while acquiring the relevant mathematical concepts. They further suggest "the known is the bridge over which students cross to gain the to-be-known. This bridging or connecting is not a simple association between what is already known and what is new; it is an active process of sorting, analysis, and interpretation" (p. 29).

Assessment and Context

An important component in this bridging is an accurate assessment of what the student brings to the classroom. Sociocultural approaches to assessment value the role that context plays and are concerned with the ways in which its influence can be described and measured. Wineburg (1997) contrasts Vygotskian approaches to traditional approaches that focus on the individual.

> In contrast to traditional psychometric approaches, which seek to minimize variations in context to create uniform testing conditions, Vygotsky argued that human beings draw heavily on the specific features of their environment to structure and support mental activity. In other words, understanding how people think requires serious attention to the context in which their thought occurs. (p. 62)

Language Use and Context

Lily Wong-Fillmore (1985) contributes to a broader understanding of context through her studies of teachers' language use in the classroom. In analyzing successful environments for learning a second language, she examines both the linguistic input of teachers as well as their ability to contextualize language. Wong-Fillmore's studies illustrate that context is a widely shared concern among sociocultural theorists and one that virtually needs redefinition for different situations. Kozulin et al. (2003) provide such a redefinition by looking at Vygotsky's theory as it is applied in educational contexts. Giving a significantly different perspective on context, Dillon, Bayliss, Stolpe, and Bayliss (2008) contrast a Western view with a Mongolian.

> In Western educational situations, structures, contexts and schemata are substantially pre-defined, and we talk about things as "context-dependent," since context is something that can be described as the backdrop to behaviour. In Mongolia both meaning and context emerge from people's interactions with their environments and may subsequently be described. (p. 18)

Culture and Context

The specific description of context is not separated from the process being studied and needs to include cultural considerations, as each context may call for distinct approaches. John-Steiner (1995), for example, found that story retelling was an effective elicitation method for many children, but was not as effective with Navajo children until traditional winter tales were substituted for the generic stories she had used with mainstream students. Similarly, Tharp found that collaborative groupings that he used successfully with Hawaiian students did not work with Native American students where considerations of clan and gender had to be included in decisions about how to pair children. Griffin, Belyaeca, Soldatova, and Velikhov–Hamburg (1993) included other elements that play a role in context: “the semantic significance of grammatical constructions, the media and mediation, communicative acts, social roles and classes, cultural (and ethnic) conventions and artifacts, institutional constraints, past history, and negotiated goals imaging the future” (pp. 122–123).

Sociocultural researchers whose studies focus on the workplace as a setting for learning also stress the importance of context. The Finnish researcher Yrjö Engeström (1994, 1999) and his collaborators (Engeström, Miettinen, & Punamäki, 1999) looked at school, hospital, outpatient, and industrial contexts. In their recent work they emphasized *knotworking*, which they define as “the notion of knot refers to a rapidly pulsating, distributed and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems” (1999, p. 346). Their application of activity theory helped them to bridge the gaps between micro- and macro-levels of analysis and also to move beyond the models of linear causation prevelant in the physical sciences. The basic premise of Engeström’s and his colleague’s work is that the nature of phenomena is revealed in change, a focus of Vygotsky’s experimental work. Engeström describes Vygotsky’s experiments as having four moments or steps, which he decribes as first, observation of rudimentary everyday behavior; then, reconstruction of the historical phases of the cultural evolution of that behavior; next, experimental production of change from the rudimentary to higher forms of behavior and, finally observation of actual development in naturally occurring behavior (Minnis & John-Steiner, 2001).

Among linguists, Michael Halliday (1978) is most emphatic in emphasizing the role of context, as seen in his influential book, *Language as Social Semiotic*. He succinctly summarized the relationship between language and context: “The context plays a part in what we say; and what we say plays a part in determining the context” (p. 3). This echoes Vygotsky’s dialectical analysis which examines how the individual shapes context and language and in turn how they shape the individual.

MEDIATION AND HIGHER PSYCHOLOGICAL PROCESSES

The way that language use contributes to the development of a *system of meaning* was a central concern of Vygotsky’s and is key to understanding the intricate dialectical relationships that he described as existing between language, thought, and consciousness. At the end of *Thinking and Speech*, Vygotsky draws on Marx and Engels’ *German Ideology* to describe this dialectical relationship.

> If language is as ancient as consciousness itself, if language is consciousness that exists in practice for other people, and therefore for myself, then it is not only the development of thought but the development of consciousness as a whole that is connected with the development of the word. (Vygotsky, 1987, p. 285)

Language and thought in a dialectical unification, create verbal thinking, which is the foundation for the development of consciousness. The interconnections form a system in which language, thought, and social interaction influence one another as meaning is created.

In this section we examine one of the most influential and most original aspects of Vygotsky’s legacy: his analysis of language’s mediational role in the development of higher mental functions and the creation of the system of meaning. In his study of the higher mental functions, Vygotsky (1997a) described two distinct streams of development of higher forms of behavior, which were inseparably connected but never merged into one:

> These are, first, the processes of mastering external materials of cultural development and thinking: language, writing, arithmetic, drawing; second the processes of development of special higher mental functions not delimited and not determined with any degree of precision and in traditional psychology termed voluntary attention, logical memory, formations of concepts, etc. (p. 14)

Vygotsky’s analysis of the role of language, writing, and arithmetic in cultural development helps us understand how psychology might guide educational approaches to teaching/learning. An important part of his analysis of the development of higher mental functions in a system of meaning is the way that verbal thinking facilitates concept formation and language acquisition.

Language Acquisition

Contemporary scholars, such as Rogoff (2003), Tomasello (1999, 2008), Toomela (2003), and Wenger (2011), among many others, have added to Vygotsky's theoretical claim that language is central to human mental development in a variety of ways, including showing "how symbolic thinking emerges from the culture and community of the learner" (NRC, 1999, p. 14). Vygotsky (1981) included important cultural and psychological tools in addition to language, such as mathematical symbols, maps, works of art, and mechanical drawings that serve to shape and enhance mental functioning. These socially constructed semiotic means are transmitted and modified from one generation to the next. Language, as the chief vehicle of this transmission, is a cultural tool (Wertsch, 1991).

Speaking and Thinking

Studying the relationship between thinking and speaking was at the center of Vygotsky's work. He conceived of two distinct and originally separate processes: prelinguistic development of thought and preintellectual development of expressive and social communication. These two paths of development become interdependent when children shift from receiving words to actively seeking language from the people around them in order to communicate their needs. The merger of the expressive verbal and intellectual lines of development gives rise to the earliest forms of verbal thinking and communicative, intelligent speech. This change is manifested in children's constantly asking for names of things, leading to an extremely rapid increase in their vocabulary. In this process the "child makes what is the most significant discovery of his life" (Vygotsky, 1987, pp. 110–111), the discovery that each object has a *name*, a permanent symbol, a sound pattern that identifies it.

The connection between objects and their referents is not easy to establish because it requires multiple cognitive processes and it proceeds by fits and starts. This connection is also linked to the development of practical thinking, to the toddlers' manipulation of objects, and to their practical activities as well as to emotional and expressive behavior. "Laughter, babbling, pointing, and gesture emerge as means of social contact in the first months of the child's life" (Vygotsky, 1987, p. 110).

Vygotsky examined semiotic mediation, including language, developmentally. His theory stresses that social functions of speech (1986 & 1987) and the fact that human survival is dependent on sustained attention to and care of others. Therefore, the earliest efforts at communication require careful, finely tuned, caretaker interpretations:

> From the moment of birth this adaptation places the infant into social relations with adults and through them into a sociocultural system of meaning. Thus the requirements of care allow the infant's individuality to develop with cultural sources and also provide the communicative formats necessary for the development of language. (John-Steiner & Tatter, 1983, p. 87)

Socialization of Attention

As a foundation for understanding adult references, the young learner has to share an attentional focus with the adult through a process of *socialization of attention*. "We have called this process in which caregivers specify culturally relevant and socially shared topics perceptually for the child's benefit *socializing attention.* In socializing attention caregivers use both gesture and speech" (Zukow-Goldring & Ferko, 1994, p. 177). Although children are dependent on their caregivers, the windows of opportunity to create joint attention are short because their attention is intermittent with their gazes shifting from faces to objects. Before infants appropriate linguistic meaning they have to follow the adult's gaze and have their modes of expression interpreted.

Research by Scaife and Bruner in 1975 highlighted the Vygotskian notions of *shared attention* and *joint activity*, which start when a child is very young. They demonstrated that infants follow the gaze of adults and pay selective attention to those aspects of their environment that are also of interest to those around them. Katherine Nelson (1989) showed that the creation of scripts by the infant and the adult, necessary for language acquisition, also supports shared attention. "Children like to talk and learn about familiar activities, scripts or schemes, the 'going to bed' script or the 'going to McDonald's' script" (NRC, 1999, p. 96). Bruner (1985) argued that sharing goes beyond the immediacy of gaze and reciprocal games—that it illustrates the principle of *intersubjectivity*, which is critical to the acquisition of language. Stein Bråten (2009) has done extensive research with infants on intersubjectivity and the evolution of speech and has compiled an edited volume (2006) that addresses the role of emotion in the acquisition of intersubjective communication.

Intersubjectivity and Language Acquisition

Rommetveit (1985, p. 187) relates the intersubjectivity of the young child to an adult's as he described an inherent paradox in intersubjectivity. He starts by drawing on

William James's (1962) quote, "*You accept my verification of one thing. I yours of another. We trade on each other's truth*" (p. 197). Explanations of language acquisition that rely on biologically hardwired mechanisms tend to diminish the role of social interaction and intersubjectivity. The debates in the field between those who look to innate mechanisms and those who look to the sustaining impact of social interaction and finely tuned exchanges help highlight the distinction that Vygotsky drew between basic biological processes on the one hand and language as socially constructed by interactive processes on the other. These debates have important implications for education:

> The social interaction of early childhood becomes the mind of the child. Parent-child interactions are transformed into the ways the developing child thinks, as are interactions with siblings, teachers and friends . . . . In schools, then, dedicated to the transformation of minds through teaching and learning, the social processes by which minds are created must be understood as the very stuff of education. (Tharp et al., 2000, p. 45)

Intersubjectivity and Language Acquisition

The interdependence between social and individual processes in language acquisition described by sociocultural researchers illustrates the unity of distinct processes—an essential tenet of Vygotsky's methodological approach. Children are born into a culture and develop language through the communicative intent that adults bring to their children's utterances, but there is another process at play—the development of children's individual personalities: "Dependency and behavioral adaptability provide the contextual conditions for the correlative processes of individuation and enculturation, both of which are essential to the development of language" (John-Steiner & Tatter, 1983, p. 87).

In tracing the process of individuation in the development of the child, Piaget's early research, especially his concept of egocentric speech, a form of language in which the speaker uses speech for noncommunicative, personal needs influenced Vygotsky. He described the separation and transformation of social (interpersonal) speech into private speech—utterances that are vocalized but not for communicative purposes (Diaz & Berk, 1992; Winsler, Fernyhough, & Montero, 2009)—and of private speech into inner (intrapersonal) speech. Vygotsky's analysis of this internalization process provides an important example of the utility of a functional systems approach. For Vygotsky, developmental change unifies the usual polarity between those processes that occur among individuals (studied by sociologists and anthropologists) and those that occur within individuals (the domain of psychologists). In his well-known *genetic principle,* he proposed that each psychological process occurs first between the child and a more experienced adult or peer, and then gradually becomes internalized by the child. Jerome Bruner (1962) captured this aspect of sociocultural theory when he wrote, "It is the internalization of overt action that makes thought, and particularly the internalization of external dialogue that brings the powerful tool of language to bear on the stream of thought" (p. vii).

Internalization of Speech

The process of internalization, however, is not accomplished through simple imitation; rather, it involves a complex interplay of social and individual processes that include transmission, construction, transaction, and transformation. The internalization process described by Vygotsky has had a number of interpretations and remains a topic of interest among sociocultural theorists (Chang-Wells & Wells, 1993; Galperin, 1966; Haenen, 1996; John-Steiner & Mahn, 1996; Packer, 1993; Wertsch & Stone, 1985). The internalization of language and its interweaving with thought was a central focus of Vygotsky's systems analysis, which he used to examine verbal thinking—the unity formed by this interweaving. To analyze this unity, Vygotsky used the concept of *znachenie slova*. Considerable confusion about Vygotsky's use of this concept has resulted from its translation into English as "word meaning." The Russian *znachenie* translates to "meaning" and *slova* (*slovo* in its unmarked, nominative form) to "word," but *slovo* represents language as a whole as used in "In the beginning was the word." "Meaning through language use" and "meaning through the sign operation" are more accurate, expanded renditions of *znachenie slova*. It is important to make a distinction between the use of *slova* in connection with *znachenie* when it refers to language as a whole and *slova* used apart from *znachenie* to refer to particular words in reference to objects, physical and not.

Vygotsky clarified what he meant by *meaning:* "Meaning is not the sum of all of the psychological operations which stand behind the word. Meaning is something more specific—it is the internal structure of the sign operation" (1997b, p. 133). He looked at the development of meaning as a process, one that is shaped by its systemic relationship with other psychological functions, processes, structures, and systems. A central focus of Vygotsky's work is the examination of the systemic nature of consciousness and in particular the system of meaning created through language use (Mahn, 2008; Vygotsky, 1987).

The concept of *semiotic mediation* was important in his examination of the nature and development of the system of meaning. Humans learn with others as well as via the help of historically created semiotic means such as tools, signs, and practices. Yaroshevsky and Gurgenidze (1997) described the centrality language held for Vygotsky in semiotic mediation and, therefore, in the development of thinking. Language and thinking were viewed as changing and dynamic instead of constant and eternal and their relationship was part of a complex process at the center of which Vygotsky placed *znachenie slova* (meaning through language use) and *verbal thinking.*

Meaning and Verbal Thinking

Instead of isolating language as an object for study (linguistics) and thinking as another object for study (psychology), Vygotsky studied their unity and sought to discover an aspect of that unity that was irreducible and maintained the essence of the whole. The concept of *znachenie slova* (translated in the selection below as *word meaning*) provided him with the foundation for examining children's use of inner speech and verbal thinking:

> *Word meaning* is a unity of both processes [thinking and speech] that cannot be further decomposed. That is, we cannot say that word meaning is a phenomenon of either speech or thinking. The word without meaning is not a word but an empty sound. Meaning is a necessary, constituting feature of the word itself. It is the word viewed from the inside. This justifies the view that word meaning is a phenomenon of speech. In psychological terms, however, word meaning is nothing other than a generalization, that is a concept. In essence, generalization and word meaning are synonyms. Any generalization—any formation of a concept—is unquestionably a specific and true act of thought. Thus, word meaning is also a phenomenon of thinking. (Vygotsky, 1987, p. 244)

In his analysis of the relationships between thinking and speech, Vygotsky examined the origins of both and then traced their developments and interconnectedness, concluding, "These relationships emerge and are formed only with the historical development of human consciousness. They are not the precondition of man's formation but its product" (Vygotsky, 1987, p. 243).

Inner Speech

Through his analysis of *znachenie slova* in his final major work, *Thinking and Speech*, Vygotsky (1987) revealed the essence of the process of the internalization of speech in relationship to verbal thinking and concluded that "inner speech is an internal plane of verbal thinking which mediates the dynamic relationship between thought and word" (p. 279). He investigated children's appropriation of socially elaborated symbol systems as a critical aspect of their learning-driven development. These investigations led to his most fully elaborated application of the concept of internalization—the transformation of communicative language into inner speech and further into verbal thinking:

> The movement from inner to external speech is not a simple unification of silent speech with sound, a simple vocalization of inner speech. This movement requires a complete restructuring of speech. It requires a transformation from one distinctive and unique syntax to another, a transformation of the sense and sound structure of inner speech into the structural forms of external speech. External speech is not inner speech plus sound any more than inner is external speech minus sound. The transition from inner to external speech is complex and dynamic. It is the transformation of a predicative, idiomatic speech into the syntax of differentiated speech, which is comprehensible to others. (pp. 279–280)

As the condensed, telegraphic, predicative style of inner speech is hard to access overtly, it rarely occurs in ordinary conversation. Vygotsky used Piaget's concept of egocentric speech to analyze the internalization of speech, but instead of claiming that egocentric speech just disappeared with increased socialization as claimed by Piaget, Vygotsky argued that egocentric speech is internalized and becomes inner speech. By examining the character of egocentric speech and the processes through which it is internalized, Vygotsky was able to reveal the essence of inner speech. He also relied on literary examples to illustrate inner speech. The most famous was the account from Tolstoy's *Anna Karenina* in which Kitty and Levin declare their love for each other by relying solely on the first letters of words. Vygotsky's interpretation of this conversation of condensed exchanges was that the participants were so deeply involved with each other that there was minimal psychological distance between them. Their expressive means then became reduced to the smallest possible units as well.

While looking for related forms that reveal the dynamics of inner speech, John-Steiner (1985a) examined the notebooks of writers. In several writers' diaries, she found condensed, jotted notes through which these writers, including Virginia Woolf, Henry Miller, and Dostoyevsky, planned their chapters and books. "Use of a telegraphic style makes it possible to gallop ahead, exploring new connections . . . . Often when there is a transcribed record of the way in which writers plan their work, it takes the form of these very condensed thoughts" (p. 112). These planning notes that John-Steiner named *inner speech writing* reveal two aspects of verbal thinking, *sense* and *meaning* as related to the use of language.

Meaning and Sense in a System of Meaning

A word's sense is the aggregate of all the psychological facts that arise in our consciousness as a result of the word. Sense as a dynamic, fluid, and complex formation has several zones that vary in their stability. Meaning is only one of these zones of the sense that the word acquires in the context of speech. It is the most stable, unified, and precise of these zones. In different contexts, a word's sense changes. In contrast, meaning is a comparatively fixed and stable point, one that remains constant with all the changes of the word's sense that are associated with its use in various contexts (Vygotsky, 1987, p. 276).

It is important to remember that in his writings on *sense* in *Thinking and Speech*, Vygotsky focuses primarily on sense as the "unique semantic structure" of *inner* and describes the basic characteristics of the semantics of inner speech. To illustrate the nature of sense, he draws analogies to external speech primarily related to "literary speech" but makes clear that these analogies do not imply an equivalency in the use of *sense* as related to sociocultural meanings in external speech and as it is used in relationship to inner speech. Children's first words are dominated by the sense of visual perception and their emotional experience of the context in which a word is being used. Their sense, therefore, dominates initially, but then the adult/sociocultural meanings of words begin to play a more significant role in the ways in which they make meanings in their social situations of development. Vygotsky cautions that the "child's word may correspond with the adult's in object relatedness, but not in meaning" (1987, p. 153).

A word and its meaning change through internalization—the process through which sociocultural meaning is incorporated into an individual's sense. "The meaning of the word in inner speech is an individual meaning, a meaning understandable only in the plane of inner speech" (p. 279). "To some extent, [sense] is unique for each consciousness and for a single consciousness in varied circumstances" (p. 276). Therefore, the sense of a word is never complete. Sense is "the aggregate of all the psychological facts that arise in our consciousness as the result of the word" (pp. 275–276) and is a transformative component in the development of the system of meaning. "Ultimately, the word's real sense is determined by everything in consciousness which is related to what the word expresses . . . [and] ultimately sense depends on one's understanding of the world as a whole and on the internal structure of personality" (p. 276).

Essential to the development of the system of meaning is the *lifelong*, dynamic, dialectic interplay between sociocultural meaning and the sense that develops as a part of the system of meaning. Sense and the system of meaning both develop through the internalization of sociocultural meanings. In this process there is an ongoing dialectical interaction between, on the one hand, the system of meaning and the plane of sense within it and, on the other, the existing, relatively stable, external sociocultural meanings. The way in which sociocultural meaning is transformed as it is internalized can be seen at the level of single words in the difference between the individual's sense of the word and common usage based on dictionary meanings. The word *mother*, for example, invokes for every individual a very personal *sense* of the word. At the same time there is a common understanding of the sociocultural meaning of the word denoting both a biological and cultural relationship. This divergence exists in both the internalization and externalization processes. Language can never fully express an individual's sense of a concept or sense of a thought.

As mentioned previously, Vygotsky utilizes different genres of language use to distinguish between meaning and *sense*. Actors use *sense* to convey the specific, contextually bound ways in which a person acts and feels. Poets use meaning and sense to convey the general and specific possibilities of a poetic image or an unexpected phrase. Meaning and sense, reflecting the changing complexity of experience, are transformed as children develop. Vygotsky's analysis of the essential role played by sense and meaning in language acquisition provides the theoretical framework for his description of the different stages of concept formation and for his work as a whole.

Language Acquisition and Concept Formation

Language depends on classification. To label two objects with the same word, a child needs to identify them as being similar in some crucial way. However, to achieve effective categorizing, children traverse through a number of phases. At first, they tend to apply words to "a series of elements that are externally connected in the impression that they have had on the child but not unified internally among themselves" (Vygotsky, 1987, p. 134). Although a child's meaning is not complete and is diffuse in its application, it will at times externally coincide with the adult's. At those points of intersection the child will "establish social interaction through words that have meaning" (p. 134), even though the child's meanings differ from those of the adult.

At the beginning of the process of categorizing objects, children develop a syncretic image, a "heap" of "objects that are in one way or another combined in a single fused image in the child's representation and perception" (Vygotsky, 1987, pp. 134–135). Through a process of trial and error, children begin to refine the syncretic image but do so "guided not by the objective connections present in the things themselves, but by the subjective connections that are given in their own perception" (p. 135). Objects that are in close proximity with each other in everyday life, but do not share any common features, may be organized together in a heap. On the other hand, the child may just have a subjective feeling that certain things belong together. When children no longer mistake the connections in their impression of objects for connections between the objects themselves, Vygotsky says that they have passed to a mode of thinking in complexes. In this mode of thinking, objects are organized by the concrete connections that exist between them. Vygotsky (1987) gives an example of a chained complex.

> The child initially used the word "kva" to refer to a duck swimming in a pond. He then used it to refer to any liquid, including the milk that he drank from his bottle. Later, when he saw a picture of an eagle on a coin, he used the same name to refer to the coin. This was sufficient for the subsequent use of the term to refer to all circular objects similar to coins. (p. 149)

In complexive thinking, "the world of objects is united and organized for [children] by virtue of the fact that objects are grouped in separate though interconnected families" (Vygotsky, 1987, p. 136). In a concept-sorting task, developed for Head Start children, John and Goldstein (1967) found that first graders tended to group cards functionally. For instance, they placed a barn, a farmer, and a horse into a single group, rather than placing the farmer with other working people and the horse with other animals. Kozulin (1990) illustrated such concrete and functional grouping of objects that complement each other (e.g., saucers and spoons). At an early stage of language use, "word meanings are best characterized as family names of objects that are united in complexes or groups. What distinguishes the construction of the complex is that it is based on connections among the individual elements that constitute it as opposed to abstract logical connections" (Vygotsky, 1987, p. 136), which is central to the construction of concepts. In order to be included in a group or complex, any empirically present connection of an element is sufficient. Language plays a significant role in facilitating the connection of objects and events.

Double Stimulation and Concept Formation

Vygotsky worked with Lev Sakharov to develop a method for studying the different stages of concept formation. They referred to their approach as the *method of double simulation*—a method in which both objects and mediating artifacts such as signs are introduced. In this case, the researchers used nonsense syllables on the bottom of the blocks of different colors, shapes, heights, and surfaces. The task of the participants was to discover a systematic way of grouping these blocks. As mentioned earlier, the youngest children grouped blocks in syncretic ways, whereas the next-older children displayed thinking in complexes. The achievement of true concepts (that of a triangle, for instance) requires not only that the mature and developing learners have a joint understanding and a common referent when they point to a triangle, but also that the developing learner has mastered the processes of analysis, separation, and abstraction—all needed to achieve the mastery of true concepts.

Paula Towsey replicated the Vygotsky/Sakharov block study with 2-, 5-, 8-, 11-, and 15-year-olds and adults. Her aim was to examine "new concept formation to find out whether contemporary children and adults produce the same or similar patterns as those described by Vygotsky" (Towsey, 2009, p. 234). "Confirmation of Vygotsky's original hypothesis concerning the different kinds of preconceptual reasoning techniques by participants of different ages was found in this study" (2009, p. 257). This study reconfirmed Vygotsky's analysis of the central role of language in concept formation in a system of meaning making.

In Chapter 5 of *Thinking and Speech*, Vygotsky (1987) describes his research into meaning making and concept formation, in which he examines the roles of generalization and categorization in language development and concept formation. This research reveals the ways in which communication is central to concept formation, and how children and adolescents master concepts. As semantic mastery is achieved, *meaning* continues to develop further through social interaction and learning.

Everyday and Scientific Concepts

Vygotsky was not fully satisfied by these studies because he realized the artificiality of the tasks, particularly in the reliance on nonsense syllables in guiding the sorting process. He subsequently moved to another aspect of concept formation, drawing a basic distinction between everyday and scientific concepts—work partially informed by Piaget's work on spontaneous and nonspontaneous concepts. Everyday concepts are developed in the context of the child's experiences in noninstructional settings and are supported by the young learner's engagement in joint activities. Adults do not teach these concepts in a systematic fashion. A frequently used example of an everyday concept is that of *brother*. A child correctly identifies his or her own brother, or those of friends, without being able to define it in a more systematic way as a "male sibling." In Chapter 6, Vygotsky (1987) defined scientific concepts as ones usually introduced to the child in school: "*The system emerges only with the development of the scientific concept and it is this new system that transforms the child's everyday concepts*" (p. 223).

Vygotsky (1987) noted that before scientific concepts could emerge, higher mental functions such as "voluntary attention, logical memory, abstraction, comparison, and differentiation" (p. 170) needed to develop. When scientific concepts do emerge, there is a "complete restructuring of the child's spontaneous concepts" (p. 236), with scientific concepts providing "the gate through which conscious awareness enters the domain of the child's concepts" (p. 193). Vygotsky described the gap between spontaneous and scientific/academic concepts as constituting the zone of proximal development. He added, "The basic characteristic of [scientific concepts'] development is that they have their source in school instruction. Therefore, the general problem of instruction and development is fundamental to the analysis of the emergence and formation of scientific concepts" (p. 214).

Context and Concept Formation

In a study conducted in the upper Amazon region of Brazil, Elvira Lima (1998) examined concept formation in her work with Indian teachers from the Tikuna tribe. Over a period of three years, she learned about the ways in which members of this community, as a part of their learning, relied on drawing as culturally shaped mediation: "Tikuna culture uses body and nature dynamically as supports for graphic representation to convey meaning. Even orality in the school culture is functionally articulated with visual production" (Lima, 1998, p. 97). Drawing is thus a central mode of expression among this large tribe, whose members are committed to cultural continuity while embracing school-based learning as a mode of survival. In her work with the lay teachers (individuals who were simultaneously teaching and obtaining their certification), Lima introduced two scientific concepts: the *developing child* and the *milieu* adopted from the French cultural-historical theorist, Henri Wallon (1879–1962).

Because drawing and graphic representations are central to the way in which the Tikuna make meaning of and interact with their world, Lima used this medium to capture key features of the tribe's world, including the central role of the forest in which the tribe lives. She also relied on the notion of contrast for teaching the concept of *milieu* and showed a documentary on the Masai people from Africa. The words in the documentary were in English, but the teachers who did not know English captured the "meaning" of the film by relying on the visual elements and the music. They conveyed their own understandings of this unfamiliar milieu by drawings assembled into a mural and placed on the wall of the school. Verbal and written activities, including contrastive structures between the tribe's native language and Portuguese, further developed the concept. The study of the milieu led easily to exploring the lay teachers' concepts of how the Tikuna child develops through instruction designed to construct a scientific concept of the developing child.

Lima had the opportunity to evaluate how her students, the lay teachers, appropriated the concepts that she was teaching them over time. She alternated between intensive periods of teaching and travel in Brazil and abroad. After each of her trips she examined some of the new educational materials her students had developed during her absence. They reflected an increasingly sophisticated understanding of the environment, a development that revealed the mutual co-construction of academic-scientific concepts through "drawings, written Tikuna and Portuguese, oral Tikuna, and diagrams as equally relevant mediation" (Lima, 1998, p. 103). She described the learning styles of her students as the dialectical weaving together of experiential and scientific knowledge where "success [is] defined as the learning of formal knowledge [that] depends on the creation of a pedagogy that is culturally appropriate but that does not restrict the student to what he or she already experiences culturally" (p. 103).

Lima's research illustrates the dynamic interweaving of various means of representation into a functional system. It also illustrates the way in which a native language and a second language may complement each other in expanding a bilingual individual's conceptual understanding while enriching her or his sensitivity to the expanding possibilities of semantic understanding.

Concepts and First- and Second-Language Acquisition

To further clarify his theory of concept formation, Vygotsky compared the differences between scientific and everyday concepts and the differences between acquiring one's native language and a second language. Children learn their native languages without conscious awareness or intention. In learning a second language in school, the approach "begins with the alphabet, with reading and writing, with the conscious and intentional construction of phrases, with the definition of words or with the study of grammar" (Vygotsky, 1987, p. 221). He added that with a second language the child first must master the complex characteristics of speech, as opposed to the spontaneous use of speech evident in the acquisition of one's native language. In contrast to first language acquisition, where the young child focuses primarily on communicative intent, second-language learners are more conscious of the acquisition process and the features of the target language. They are eager to approximate native use. As they listen to themselves while communicating, they refine and expand their conscious knowledge of both their first and second languages. Second-language speakers' conscious awareness of their syntax and vocabulary is well documented by researchers who focus on repairs in speech. These corrections of one's utterances during speech are common. An example of such self-repair is "I see much friends . . . a lot of friends" (Shonerd, 1994, p. 86). In suggesting that these corrections reflect the speakers' efforts to refine their linguistic knowledge, Shonerd quoted Wolfgang Klein: "The language learner must make his raincoat in the rain" (p. 82).

Vygotsky's (1987) examination of the relationships between first and second language acquisition shows how both "represent the development of two aspects of a single process, the development of two aspects of the process of verbal thinking. In foreign language learning, the external, sound and phasal aspects of verbal thinking [related to everyday concepts] are the most prominent. In the development of scientific concepts the semantic aspects of this process come to the fore" (pp. 222–223). He added another comparison between learning scientific concepts and learning a second language. The meanings that a student is acquiring in a second language are mediated by meanings in the native language. Similarly, prior existing everyday concepts mediate relationships between scientific concepts and objects (Vygotsky, 1987). Vygotsky cautions, however, that "the learning of the native language, the learning of foreign languages, and the development of written speech interact with each other in complex ways. This reflects their mutual membership in a single class of genetic processes and the internal unity of these processes" (Vygotsky, 1987, p. 179). The unity Vygotsky found in inner speech, verbal thinking, and meaning has been a focus for sociocultural researchers, especially those looking at these three aspects in second-language learners who are trying to create meaning in a new language.

SOCIOCULTURAL APPROACHES TO SECOND-LANGUAGE ACQUISITION AND DEVELOPMENT

Researchers interested in diverse facets of second-language acquisition both in and out of educational contexts, have utilized sociocultural theory in a variety of ways. Some have focused more on the internal aspects of language, the mental processes involved in making and communicating meaning through language acquisition, while others have focused more on the social, cultural, physical, and historical contexts of second-language learning and acquisition. All have strived to understand second-language learning and acquisition and examine the role of sociocultural *context* as a mediating force in language development and use and have recognized the essential role of semiotic mediation—making meaning through signs—in the development of the mind.

James Lantolf has played a central role in developing a sociocultural approach to the study of second-language acquisition (SLA) and second-language teaching/learning. He and his students and colleagues have developed a methodological approach to researching second-language acquisition based on the work of Vygotsky using mediation; inner speech, private speech, and internalization; the regulatory function of language; the zone of proximal development and scaffolding; testing, including dynamic assessment. (Lantolf, 2000; Lantolf & Appel, 1994; Lantolf & Poehner, 2008; Lantolf & Thorne, 2006). Lantolf and Beckett (2009) reviewed sociocultural research investigating SLA from 1985 to the present. Mahn (2013) similarly describes aspects of Vygotsky's methodology and theory that have guided sociocultural approaches to SLA research.

Vygotsky's Influence on Literacy Research

In the same way that Vygotsky's work helped provide a sociocultural foundation for second-language research, it also provides a foundation for first language literacy studies. Writing theorists such as Emig (1971), Britton (1987), Langer and Applebee (1987), and Moffett (1981) constructed a new approach to literacy that relied on Vygotsky's key ideas. His influence has also been important in the development of reading theories by Clay (1991), Holdaway (1979), K. Goodman and Goodman (1990), and Taylor (1998). Among the topics explored by these literacy researchers are sociocultural considerations of the literacy socialization process (Panofsky, 1994).

In the "Prehistory of Written Language," Vygotsky (1978) examined the roles of gesture, play, and drawing in the socialization for literacy. He analyzed the developmental processes children go through before schooling as a foundation for literacy learning in school. He argued that gestures lay the groundwork for symbol use in writing: "The gesture is the initial visual sign that contains the child's future writing as an acorn contains a future oak. Gestures, it has been correctly said, are writing in the air, and written signs frequently are simply gestures that have been fixed" (Vygotsky, 1978, p. 107). In a study on parent-child book reading, Panofsky (1994) also emphasized the importance of connecting visual signs with verbal representations. She suggested that children need assistance in interpreting pictures in books, a process that contributes to the move from signs to representations. An example of such a move is a parent's saying, "See that tear? He is crying" (Panofsky, 1994, p. 232). Anne Dyson (1989), who has shown the importance of dramatic play, drawing, and writing in the development of child writers, also emphasized the multidimensionality of literacy.

Vygotsky (1978) described the interweaving of diverse forms of representation such as scribbles accompanying dramatic play: "A child who has to depict running begins by depicting the motion with her fingers, and she regards the resultant marks and dots on paper as a representation of running" (p. 107). When children use symbols in drawing, writing development continues. As they begin to draw speech, writing begins to develop as a symbol system for children.

Implications for Teaching

The emphasis on the functions of writing for children is paramount among contemporary literacy scholars (Smith, 1982). Such an emphasis also characterizes Vygotsky's thoughts and predates some of the current, holistic approaches to reading and writing: "Teaching should be organized in such a way that reading and writing are necessary for something . . . writing must be 'relevant to life.' And must be taught naturally . . . so a child approaches writing as a natural moment in her development, and not as training from without. In the same way as they learn to speak, they should be able to learn to read and write" (1978, pp. 117–119). The contributors to *Vygotskian Perspectives on Literacy Research* (Lee & Smagorinsky, 2000) expand on the zone of proximal development (Lee, 2000), present cross-cultural studies of teachers' socialization and literacy instruction (Ball, 2000), and describe different approaches to classroom literacy practices (Gutiérrez & Stone, 2000), among other topics. Literacy learning, from a sociocultural perspective, is situated in a social milieu and arises from learners' participation in a community's communicative practices. These studies highlight the relationships between context and individual and social processes and at the same time underscore the need to develop environments for literacy teaching/learning that honor linguistic and cultural diversity (Mahn & John-Steiner, 2005). This is especially important for teaching students who are learning in English as a second language, as Lantolf and Beckett (2009) highlight in their extensive annotated bibliography of sociocultural research done on second language learning in classroom contexts.

A Study of Second Language Writers

Using Vygotsky's theoretical framework and methodological approach, Mahn (1997, 2008) created an environment that honored the linguistic and cultural diversity of his students who were learning to write in English as a second language. To examine ways in which Vygotsky's theories of inner speech, verbal thinking, and meaning making helped clarify the points of unity in the processes of first and second language acquisition, he studied ways in which Vygotsky's work could be realized through an efficacious pedagogical approach for culturally and linguistically diverse students. In a 3-year-long study, Mahn (1997, 2008) examined the role of inner speech, verbal thinking, culture, discourse, and affect in 74 college students from 27 different countries learning to write in a second language. Mahn used Vygotsky's theoretical framework, particularly the concept of *perezhivanie*, to analyze students' perceptions of the use of written dialogue journals with their instructor as a means to build their self-confidence and to help them with academic writing.

Vygotsky used the concept of *perezhivanie* to examine the process through which humans experience and make meaning of their social existence. Although there is no adequate translation in English of the Russian term *perezhivanie* and single or two-word translations do not do justice to the concept, it refers to the process through which humans perceive, emotionally experience, appropriate, internalize, and understand interactions in their environment (Mahn, 2003). This concept was used by Mahn to analyze student perceptions of the use of dialogue journals, which were gathered through interviews, questionnaires, reflective quick writes, their journals, and in academic essays. The students' insights helped illuminate the role played by inner speech and verbal thinking in their composing processes. Particularly revealing were their descriptions of obstacles in the movement from thought to written speech and the effect of these blockages on inner speech and verbal thinking. As one student artfully phrased what happened to her ideas if she focused on mechanics: "When I have idea in my head and I start to make it go down my arm to the paper, if I think about grammar, structure my idea blocks into my elbow and never goes to the paper" (Mahn, 1997, p. 253). Using a functional system approach to examine the alternative strategies that students used when blockages occurred, Mahn focused on the students' descriptions of the interruptions or blockages in both the internalization and externalization processes they experienced when writing in a second language. Students reported that the main cause of interruption of these processes was an overemphasis on correctness in their previous instruction. They described the tension between having a thought or concept and it becoming lost as they struggled to produce it correctly. They had the concept in their first language system of meaning but not the words to express it in a second language. They did not have to recreate the concept in their second language, but needed to get the vocabulary and structure of their new language to express the concept. Using his functional systems approach and his concept of system of meaning, Vygotsky (1997) examined this tension in his writings on bilingualism.

Vygotsky and Bilingualism

Vygotsky was particularly interested in the issue of bilingualism because of the many nationalities represented in Russia, which presented complicated challenges for educators. In his discussion of the psychological and educational implications of bilingualism, Vygotsky stressed an important aspect of a functional systems approach discussed previously: the unification of diverse processes. The achievement of balanced, successful bilingualism entails a lengthy process. On the one hand, it requires the separation of two or more languages at the production level, that is, the mastery of autonomous systems of sound and structure. At the same time, at the level of verbal meaning and thought, the two languages are increasingly unified. "These complex and opposing interrelationships were noted by Vygotsky, who had suggested a two-way interaction between a first and second language . . . .The effective mastery of two languages, Vygotsky argued, contributes to a more conscious understanding and use of linguistic phenomena in general" (John-Steiner, 1985b, p. 368). His concept of inner speech played an important role in the separation and combination of the two languages.

Writing and Inner Speech

In his analysis of verbal thinking, Vygotsky (1987) traced the internalization of meaning from external speech to its innermost plane—the affective-volitional plane that lies behind and motivates thought. He also examined the reverse process of externalization, which "moves from the motive that gives birth to thought, to the formation of thought itself, to its mediation in the internal word, to the meanings of external words, and finally, to words themselves. However, it would be a mistake to imagine that this single path from thought to word is always realized" (p. 283). The study of language has revealed the "extraordinary flexibility in the manifold transformations from external to inner speech" (John-Steiner, 1985a, p. 118) and from inner speech to thought. In Mahn's study (1997, 2008) students described using dialogue journals to overcome obstacles in both the internalization and externalization processes and to expedite inner speech's function of facilitating "intellectual orientation, conscious awareness, the overcoming of difficulties and impediments, and imagination and thinking" (Vygotsky, 1987, p. 259).

The differentiation of speech for oneself and speech for others, a process in which social interaction plays a crucial role, is an important part of this process. An interlocutor in oral speech helps achieve intersubjective understanding through intonation, gesture, and creation of a meaningful context centered on communicative intent. This recognition of speech for others leads to a differentiation between speech for others and speech for oneself. Until that realization, egocentric speech is the only mode a child uses. The differentiation of speech functions leads to the internalization of "speech for oneself" and then to inner speech. When the differentiation is extensive, we "know our own phrase before we pronounce it" (Vygotsky, 1987, p. 261). It is the struggle to "know the phrase" that can provide a stumbling block for second-language learners. For them, the movement from thought to production is often problematic, especially if they have learned English through a grammar-based approach.

The way that a child or student acquires a second language has an impact on the development of inner speech and verbal thinking. Inner speech functions differently for children learning the second language simultaneously than it does for those learning the second language through traditional, grammar-based approaches in school. If awareness of correctness dominates, affective factors, including those that result from different cultural practices, may impede the internalization of English and disrupt verbal thinking. In Mahn's study a number of students who described this disruption in their thinking or composing processes added that when they wrote in their dialogue journals without worrying about correctness, their ideas were both more accessible and easier to convey. They also reported that disruption was less likely to occur if they were able to describe an event that occurred in the context of their native language using their native language and one that occurred in an English context in English.

Writing and Verbal Thinking

John-Steiner (1985a) underlined the importance of drawing on the perspectives of writers when looking at aspects of verbal thinking: "A psychological description of the processes of separation and unification of diverse aspects of language is shallow without a reliance on the insights of writers, they who have charted the various ways in which ideas are woven into text" (p. 111). Because it is a more deliberate act, writing engenders a different awareness of language use. Rivers (1987) related Vygotsky's discussion of inner speech and language production to writing as discovery: "As the writer expands his inner speech, he becomes conscious of things of which he was not previously aware. In this way he can write more than he realizes" (p. 104). Zebroski (1994) noted that Luria looked at the reciprocal nature of writing and inner speech and described the functional and structural features of written speech, which "inevitably lead to a significant development of *inner speech.* Because it delays the direct appearance of speech connections, inhibits them, and increases requirements for the preliminary, internal preparation for the speech act, written speech produces a rich development for inner speech" (p. 166).

Obstacles in Writing

Problems arise for second language writers when the "rich development" becomes mired during the time of reflection, when they perform mental "grammar checks" on the sentences under construction. Students' descriptions of this process indicate that during this grammar check they lose the unity between inner speech and external speech and consequently lose their ideas. Vygotsky (1987) wrote that whereas "external speech involves the embodiment of thought in the word, in inner speech the word dies away and gives birth to thought" (p. 280). The problem for students who focus excessively on correctness is that the words do not become the embodiment of thought; nor do they "die." Students will wait to write down a thought until they have created in their mind what they feel is a grammatically correct sentence. In the meantime, the thought dies, and the motivation for communication diminishes. When the students take the focus off correctness, students are able to draw more on inner speech and their verbal thinking when composing. Vygotsky (1987) took the analysis of internalization beyond pure thought locating the motivation for thought in the affective/volitional realm:

> Thought has its origins in the motivating sphere of consciousness, a sphere that includes our inclinations and needs, our interests and impulses and our affect and emotion. The affective and volitional tendency stands behind thought. Only here do we find the answer to the final "why" in the analysis of thinking. (p. 282)

When students used only those words or grammatical forms that they knew were correct, they felt that they could not clearly transmit ideas from thought to writing. If they did not focus on correctness, they took chances and drew on the word meanings in their native language as a stimulus to verbal thinking. This helped them develop their ideas (e.g., "Journals helped me to think first; to think about ideas of writing instead of thinking of the grammar errors that I might make"). They describe how verbal thinking helped in the move to written speech because it was initiated with the intent of communicating an idea rather than producing the correct vocabulary, spelling and usage, sentence structure, genre, or rhetoric.

Shaughnessy (1977) observed that the sentence unfolding on paper is a reminder to the basic writer of the lack of mechanical skill that makes writing down sentences edited in the head even more difficult. In more spontaneous writing, writers do not have a finely crafted sentence in their head; rather, as in oral speech, the writer, at the time of initiation, will not know where the sentence will end. For ESL students, the focus on form short-circuits the move to inner speech, and the thought process and writing are reduced to the manipulation of external speech forms. Students in Mahn's study related that through writing in their dialogue journals they decreased the attention to surface structure and experienced an increased flow of ideas inward and outward. With this increased flow, a number of students reported that they benefited from the generative aspect of verbal thinking (e.g., "With the journal you have one idea and start writing about it and everything else just comes up"; "They seemed to help me focus on what I was writing in the sense that I let the words just flow and form by themselves."

In this chapter, we have examined the ways in which Vygotsky's ideas help us to understand and redefine teaching/learning contexts by focusing on language acquisition, verbal thinking, concept formation, second language acquisition, and literacy. In the last section we briefly describe some of Vygotsky's work in other domains—special education, assessment, and collaboration—as they relate to efforts to reform education to meet the needs of all students.

VYGOTSKY'S CONTRIBUTIONS TO EDUCATIONAL REFORM

Two volumes—*Learning for Life in the 21st Century: Sociocultural Perspectives on the Future of Education* (Wells & Claxton, 2002) and *Vygotsky and Culture of Education: Sociocultural Theory and Practice in the 21st Century* (Kozulin et al., 2003)—add to the already considerable corpus of research that uses Vygotsky's theory to understand educational psychology and educational reform. As mentioned previously, Vygotsky played a significant role in shaping education in the Soviet Union following the 1917 revolution. One of the great challenges for educators then, as now, was providing appropriate education for students with special needs. These students had been severely neglected under the czar: "A tragic product of the years of war, revolution, civil strife, and famine was the creation of an army of homeless, orphaned, vagrant, abandoned, and neglected children—about seven million of them by 1921–1922" (Knox & Stevens, 1993, p. 3). Vygotsky's approach to educating these children speaks across time to educators today who are developing inclusive education environments that serve the needs of special learners and all students. His views on the social construction of concepts of "disability," "defect" (which was the common term in Vygotsky's time), or "exceptionality" also speak to us across the decades.

Special Needs Children and Development

> A child whose development is impeded by a defect is not simply a child less developed than his peers; rather he has developed differently . . . a child in each stage of his development in each of his phases, represents a qualitative uniqueness, i.e., a specific organic and psychological structure; in precisely the same way a handicapped child represents a qualitatively different, unique type of development. (Vygotsky, 1993, p. 30)

In a special issue of *Educational Psychologist* devoted to Vygotsky's ideas, Boris Gindis (1995) described the emphasis that Vygotsky placed on the variety of psychological tools that had been developed to help students with special needs: "Vygotsky pointed out that our civilization has already developed different means (e.g., Braille system, sign language, lip reading, finger spelling, etc.) to accommodate a handicapped child's unique way of acculturation through acquiring various symbol systems" (p. 79). Signs, as used by the deaf, constitute a genuine language with a complex, ever-expanding lexicon capable of generating an infinite number of propositions. These signs, which are embedded in the rich culture of the deaf and represent abstract symbols, may appear pantomimic, but nonsigners cannot guess their meaning. The "hypervisual cognitive style" (Sacks, 1989, p. 74) of the deaf, with a reliance on visual thought patterns, is of interest in this regard: "The whole scene is set up; you can see where everyone or everything is; it is all visualized with a detail that would be rare for the hearing" (p. 75). Sign language is but one example of the multiplicity of semiotic means in the representation and transformation of experience. The diversity of the semiotic means and psychological tools is of special interest to educators who work in multicultural settings and with children who have special needs.

In two special issues of *Remedial and Special Education* devoted to sociocultural theory (Torres-Velásquez, 1999, 2000), educators and researchers reported on studies using Vygotsky's theory as a framework and addressed two important considerations: the ways in which the needs of children are determined and the ways in which their performance is measured and assessed. Linguistic and cultural diversity among students with special needs adds a layer of complexity to this process. The challenge is to develop assessment that is authentic and that is sensitive to the diversity in the ways in which students process and communicate information.

Assessment and Standardized Testing

Assessment is an integral part of the teaching/learning context but it is becoming more focused on standardized testing through the intervention of politicians and education administrators. There are broad implications for pedagogy resulting from the push to make such testing more pervasive. Vygotsky's earliest work critiqued the standardized intelligence tests being developed at that time, resulting in his being considered as the founding father of dynamic assessment (Guthke & Wingenfeld, 1992; Lidz, 1995; Minick, 1987). He argued that standardized IQ tests did not adequately account for natural and cultural processes, and could not determine what role culture or disability played in their results (Gindis, 1999).

One of the most important considerations of dynamic assessment is making sure that there is not a bias against linguistically and culturally diverse students. Sybil Kline (2001), through the Center for Research on Education, Diversity, and Excellence, produced a report on the development of alternative assessment for such students. The Opportunity Model is based on cultural-historical theory and the research of Vygotsky and Luria. This nondiscriminatory approach to special education evaluation has as key features “a socioculturally-based alternative to the IQ test, and the introduction of the concepts of ‘teachability,’ ‘opportunity niche,’ and ‘cognitive nurturance’ into the special education eligibility and intervention process” (Kline, 2001, p. 3).

Sociocultural critics also argue that because knowledge construction is social, “a focus on individual achievement actually distorts what individuals can do” (Wineburg, 1997). There is reluctance among those researchers who rely on traditional psychometrics to try to assess the role of collaboration, as they view even minimal collaboration as a threat to the validity of their studies. In an era of packaged instructional programs and teaching to standardized tests, authentic collaborative activities tend to be pushed aside, but opportunities for students to be engaged in meaningful dialogue is key to their learning and development as they jointly construct meaning.

Collaboration in Education

In describing Vygotsky’s work, we have highlighted his emphasis on the collaboration involved in the co-construction of thinking, meaning, and consciousness. Vygotsky described the development of systems of meaning that evolved from the sustained dynamic of individuals engaged in symbolic behavior both with other humans, present and past, and with material and nonmaterial culture captured in books, artifacts, and living memory. He achieved some of his most important insights by cultivating intellectual interdependence with his immediate collaborators, and with other psychologists whose writings he studied and translated into Russian (including Piaget, Freud, Claparede, Montessori, and Kohler). In this collaborative context, sociocultural theory was born (John-Steiner, 2000).

The benefits of collaboration are numerous; they include the construction of novel solutions to demanding issues and questions. Through joint engagement and activity, participants in collaboration are able to lighten the burdens of their own past socialization while they co-construct their new approaches. Rogoff, Goodman-Turkanis, and Bartlett (2001) provide a fine example of this aspect of collaboration by capturing students, returning student-tutors, teachers, and parents descriptions of an innovative educational community. The multiple voices document participatory learning in the building of a democratic collaborative and also underscore the importance of dialogue in education.

Vygotsky’s contemporaries Bakhtin and Voloshinov shared his focus on dialogue, and it remains central to sociocultural theorists today (Wells, 1999). Dialogue and the social nature of learning guided the work of Paulo Freire (1970) and provided the theoretical foundation for collaborative/cooperative learning:

> The critical role of dialogue, highlighted by both Freire and Vygotsky, can be put into effect by the conscious and productive reliance upon groups in which learners confront and work through—orally and in writing—issues of significance to their lives. (Elsasser & John-Steiner, 1977, p. 368)

It is only when participants are able to confront and negotiate their differences and, if necessary, to modify the patterns of their relationship that learning communities can be sustained. As Rogoff and her collaborators concluded: “Conflicts and their resolutions provide constant opportunities for learning and growth, but sometimes the learning is not easy” (2001, p. 239). In some cases, these conversations become so difficult that a facilitator from outside of the group is asked to assist. In spite of these difficulties, the experience of multiple perspectives in a dynamic context provides particularly rich opportunities for cognitive and emotional growth for learners of all ages.

Collaborative efforts to bring about transformative change require a prolonged period of committed activity. Issues of time, efficiency, sustained exchanges, and conflict resolution face schools that are building learning communities, but most schools are reluctant to undertake these issues. For some participants in school reform such a task is too time-consuming, and the results appear too slowly. When participants leave working, egalitarian communities, their abandonment highlights the ever-present tensions between negotiation and bureaucratic rule. Successful collaboration requires the careful cultivation of trust and dignified interdependence, which contrasts with a neat, efficient division of labor. These issues highlight the important role that affective factors play in the building of such learning communities and in creating safe, engaging, and effective teaching/learning contexts. A number of school districts throughout the United States are using professional learning communities to build a collaborative professional development model (Feger & Arruda, 2008). Another such effort is the Academic Literacy for All project, which is designed to have school-wide, collaborative professional development for secondary teachers to help them understand the importance of facilitating the language and literacy development of their English language learners at the same time that they are teaching content (Mahn & Bruce, 2010).

CONCLUSION

Faced with myriad concrete problems, teachers frequently question the need for abstract theories. Vygotsky suggested that practice challenges us to develop theory, as do the experiences of those confronted with daily problems needing urgent solutions. Practice inspires theory and is its ultimate test: "Practice pervades the deepest foundations of the scientific operation and reforms it from beginning to end. Practice sets the tasks and serves as the supreme judge of theory, as its truth criterion. It dictates how to construct the concepts and how to formulate the laws" (Vygotsky, 1997b, p. 305). To meet the challenges facing educators today, we need the influence of both theory and practice to answer the urgent questions facing us in this new century: How should we deal with the increasing linguistic and cultural diversity of our students? How do we document learning-based gains in our classrooms? How do we balance skills, knowledge, understanding and creativity? How do teachers overcome their isolation? The theory we have presented here does not answer all these questions, but it provides tools for thinking about these questions. In contrast to educational research that focuses on memorization and regurgitation tasks in controlled situations outside the classroom; sociocultural researchers study teaching/learning in classroom contexts.

The complexity of genuine learning and understanding in these classroom interactions makes it hard to summarize, but sociocultural researchers point to funds of knowledge that children bring to the classroom, to resistance among learners who are marginalized, to children's development of concepts that reflect their families and their own daily experiences, to the importance of dialogue between learners, teachers, and texts, and to the multiplicity of semiotic means and the diversity of teaching/learning contexts both within and outside of schools. Sociocultural scholars and educators view school as a context and site for collaborative inquiry, which requires the practice of mutual respect and productive interdependence.

We have emphasized an approach that looks at human activities from the perspective of functional systems: the organization and reorganization of learners' problem-solving strategies, which integrate the social and individual experiences of learners with the culturally shaped artifacts available in their societies. In this chapter we examined *meaning making* in the acquisition of first and additional languages through a functional-systems lens, focusing on Vygotsky's analysis of the development of systems of meaning.

The concept of meaning making, which was a central focus for Vygotsky throughout his life, is one that we place at the center of discussions about educational reform. The ways in which we communicate through culturally developed means need to be valued in schools. By valuing all of the ways in which children represent and appropriate knowledge, we can begin to meet the challenges that face those in the field of educational psychology in the twenty-first century: "The success of educational experiences depends on methods that foster cultural development, methods that have as a starting point the developmental processes of students and their accumulated knowledge, the developmental milieu, social practices, and the political meaning of education itself" (Lima, 1998, p. 103).

We began this chapter with a reference to the National Research Council's project on teaching and learning, and we conclude it with a quote from the book on that project that summarizes the challenges that lie ahead for educational reform:

> There are great cultural variations in the ways in which adults and children communicate, and there are wide individual differences in communications styles within any cultural community. All cultural variations provide strong supports for children's development. However, some variations are more likely than others to encourage development of the specific kinds of knowledge and interaction styles that are expected in typical U.S. school environments. It is extremely important for educators—and parents—to take these differences into account. (NRC, 1999, pp. 96–97)

REFERENCES

Antonacci, P. A. (2000). Reading in the zone of proximal development: Mediating literacy development in beginner readers through guided reading. *Reading Horizons, 41* (1), 19–33.

Aram, D., & Levin, I. (2010). Home support of children in the writing process: Contributions to early literacy. In S. B. Neumann & Dickinson, D. K. (Eds.), *Handbook of early literacy research* (Vol. 3, pp. 189–199). New York, NY: Guilford Press.

Ball, A. (2000). Teacher's developing philosophies on literacy and their use in urban schools: A Vygotskian perspective on internal activity and teacher change. In C. D. Lee & P. Smagorinsky (Eds.), *Vygotskian perspectives on literacy research: Constructing meaning through collaborative inquiry* (pp. 226–255). New York, NY: Cambridge University Press.

Bidell, T. (1988). Vygotsky, Piaget and the dialectic of development. *Human Development, 31*, 329–348.

Blanck, G. (1990). The man and his cause. In L. C. Moll (Ed.), *Vygotsky and education: Instructional implications of sociohistorical psychology* (pp. 31–58). New York, NY: Cambridge University Press.

Bodrova, E., & Leong, D. (1998). Scaffolding emergent writing in the zone of proximal development. *Literacy Teaching and Learning, 3*(2), 1–18.

Bodrova, E., & Leong, D. (2006). *Tools of the mind: The Vygotskian approach to early childhood education* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Bråten, S. (2009). *The intersubjective mirror in infant learning and evolution of speech*. Philadelphia, PA: John Benjamins.

Bråten, S. (Ed.). (2006). *Intersubjective communication and emotion in early ontogeny*. New York, NY: Cambridge University Press.

Britton, J. (1987). Vygotsky's contribution to pedagogical theory. *English in Education (UK), 21*, 22–26.

Bruner, J. (1962). Introduction. In E. Hanfmann & G. Vakar (Eds.), *Vygotsky, thought and language* (pp. v–x). Cambridge, MA: MIT Press.

Bruner, J. (1985). *Child's talk: Learning to use language.* New York, NY: Norton.

Chaiklin, S. (2001). (Ed.). *The theory and practice of cultural-historical psychology.* Oakville, CT: Aarhus University Press.

Chang-Wells, G. L. M., & Wells, G. (1993). Dynamics of discourse: Literacy and the construction of knowledge. In E. A. Forman, N. Minick, & C. A. Stone (Eds.), *Contexts for learning: Sociocultural dynamics in children's development* (pp. 58–90). New York, NY: Oxford University Press.

Clay, M. (1991). *Becoming literate: The construction of inner control.* Portsmouth, NH: Heinemann.

Cole, M. (1996). *Cultural psychology: A once and future discipline.* Cambridge, MA: Harvard University Press.

Cole, M., Gay, J., Glick, J., & Sharp, D. (1971). *The cultural context of learning and thinking: An exploration in experimental anthropology.* London, UK: Tavistock, Methuen.

Cole, M., Levitin, K., & Luria, A. (2006). *The autobiography of Alexander Luria: A dialogue with the making of mind.* Mahwah, NJ: Erlbaum.

Collignon, F. F. (1994). From "Paj Ntaub" to paragraphs: Perspectives on Hmong processes of composing. In V. John-Steiner, C. P. Panofsky, & L. W. Smith (Eds.), *Sociocultural approaches to language and literacy: An interactionist perspective* (pp. 331–346). New York, NY: Cambridge University Press.

Connery, C., John-Steiner, V., & Marjanovic-Shane, A. (2010). *Vygotsky and creativity: A cultural-historical approach to play, meaning making, and the arts.* New York, NY: Peter Lang.

Daniels, H., Cole, M., & Wertsch, J. (Eds.). (2007). *The Cambridge companion to Vygotsky*. New York, NY: Cambridge University Press.

Davydov, V. V. (1988). Problems of developmental teaching: The experience of theoretical and experimental psychological research. *Soviet Education,* Part 1: *30*(8), 15–97; Part II: *30*(9), 3–38; Part III: *30*(10), 3–77.

Davydov, V. V. (1990). *Types of generalization in instruction: Logical and psychological problems in the structuring of school curricula*. Reston, VA: National Council of Teachers of Mathematics. (Original published 1972)

Diaz, R., & Berk, L. (1992). *Private speech: From social interaction to self-regulation.* Hillsdale, NJ: Erlbaum.

Dillon, P., Bayliss, P. Stolpe, I., & Bayliss, L. (2008). What constitutes "context" in sociocultural research? How the Mongolian experience challenges theory. *Journal of Global Cultural Studies, 4*, 18–31. http://transtexts.revues.org/index244.html

Dyson, A. (1989). *Multiple worlds of child writers.* New York, NY: Teachers College Press.

Elsasser, N., & John-Steiner, V. (1977). An interactionist approach to advancing literacy. *Harvard Educational Review, 47*(3), 355–369.

Emig, J. (1971). *The composing processes of twelfth graders.* Urbana, IL: National Council of Teachers of English.

Engeström, Y. (1994). Teachers as collaborative thinkers: Activity-theoretical study of an innovative teacher team. In I. Carlgren, G. Handal, & S. Vaage (Eds.), *Teachers' minds and actions: Research on teachers' thinking and practice.* Bristol, PA: Falmer Press.

Engeström, Y. (1999). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen, & R. Punamäki (Eds.), *Perspectives on activity theory* (pp. 377–404). New York, NY: Cambridge University Press.

Engeström, Y., Miettinen, R., & Punamäki, R. (1999). *Perspectives on activity theory.* New York, NY: Cambridge University Press.

Engels, F. (1963). *The dialectics of nature.* New York, NY: International.

Feger, S., & Arruda, E. (2008). Professional learning communities: Key themes from the literature. Education Alliance, Brown University. www.alliance.brown.edu/pubs/pd/PBS_PLC_Lit_Review.pdf

Fischer, K. W., & Immordino-Yang, M. H. (2008). The fundamental importance of the brain and learning for education. In *Jossey-Bass reader on the brain and learning* (pp. xvii–xi). San Francisco, CA: Jossey-Bass.

Freire, P. (1970). *Pedagogy of the oppressed.* New York, NY: Continuum.

Galperin, P. Y. (1966). On the notion of internalization. *Soviet Psychology, 12*(6), 25–32.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences.* New York, NY: Basic Books.

Gelman, S. A. (2009). Learning from others: Children's contruction of concepts. *Annual Review of Psychology, 60*(1), 115–140.

Gindis, B. (1995). The social/cultural implication of disability: Vygotsky's paradigm for special education. *Educational Psychologist, 30*(2), 77–82.

Gindis, B. (1999). Vygotsky's vision: Reshaping the practice of special education for the 21st Century. *Remedial and Special Education, 20*(6), 333–340.

Glick, J. (1997). Prologue. In R. Reiber (Ed.), *The history of the development of higher mental functions. The collected works of L. S. Vygotsky: Vol. 4. Problems of the theory and history of psychology* (pp. v–xvi). New York, NY: Plenum Press.

Goodman, K., & Goodman, Y. (1990). Vygotsky in a whole language perspective. In L. C. Moll (Ed.), *Vygotsky and education: Instructional implications of sociohistorical psychology* (pp. 223–251). New York, NY: Cambridge University Press.

Gredler, M., & Shields, C. (2008). *Vygotsky's legacy: A foundation for research and practice.* New York, NY: Guilford Press.

Griffin, P., Belyaeca, A., Soldatova, G., & Velikhov–Hamburg, Collective. (1993). Creating and reconstituting contexts for educational interactions, including a computer program. In E. A. Forman, N. Minick, & C. A. Stone (Eds.), *Contexts for learning: Sociocultural dynamics in children's development* (pp. 120–152). New York, NY: Oxford University Press.

Guthke, J., & Wingenfeld, S. (1992). The learning test concept: Origins, state of the art, and trends. In H. C. Haywood & D. Tzuriel (Eds.), *Interactive Assessment.* New York, NY: Springer-Verlag.

Gutiérrez, K. D., & Stone, L. D. (2000). Synchronic and diachronic dimensions of social practice: An emerging methodology for cultural-historical perspectives on literacy learning. In C. Lee & P. Smagorinsky (Eds.), *Vygotskian perspectives on literacy research: Constructing meaning through collaborative inquiry* (pp. 150–164). New York, NY: Cambridge University Press.

Haenen, J. (1996). *Piotr Galperin: Psychologist in Vygotsky's footsteps*. Commack, NY: Nova Science.

Halliday, M. A. K. (1978). *Language as social semiotic: The social interpretation of language and meaning.* Baltimore, MD: University Park Press.

Hersch, R., & John-Steiner, V. (2011). *Loving and hating mathematics: Challenging the myths of mathematical life.* Princeton, NJ: Princeton University Press.

Holdaway, D. (1979). *The foundations of literacy.* New York, NY: Ashton Scholastic.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.

James, W. (1962). Pragmatism's conception of truth. In W. Barrett & H. D. Aiken (Eds.), *Philosophy in the twentieth century* (Vol. 1). New York, NY: Random House.

John, V., & Goldstein, L. S. (1967). Social context of language acquisition. In J. Hellmuth (Ed.), *Disadvantaged child* (Vol. 1, pp. 455–469). Seattle, WA: Special Child.

John-Steiner, V. (1985a). *Notebooks of the mind: Explorations in thinking.* New York, NY: Harper & Row.

John-Steiner, V. (1985b). The road to competence in an alien land: A Vygotskian perspective on bilingualism. In J. V. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 348–371). New York, NY: Cambridge University Press.

John-Steiner, V. (1991). Cognitive pluralism: A Whorfian analysis. In B. Spolsky & R. Cooper (Eds.), *Festschrift in honor of Joshua Fishman's 65th birthday* (pp. 61–74). The Hague, The Netherlands: Mouton.

John-Steiner, V. (1995). Cognitive pluralism: A sociocultural approach. *Mind, Culture, and Activity, 2*(1), 2–10.

John-Steiner, V. (1997). *Notebooks of the mind: Explorations of thinking* (Rev. ed.). New York, NY: Oxford University Press.

John-Steiner, V. (2000). *Creative collaboration.* New York, NY: Oxford University Press.

John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A Vygotskian framework. *Educational Psychologist, 31*(3/4), 191–206.

John-Steiner, V., & Osterreich, H. (1975). *Learning styles among Pueblo children.* NIE Research Grant, Final Report, Albuquerque. University of New Mexico, Department of Educational Foundations.

John-Steiner, V., Panofsky, C. P., & Smith, L. W. (Eds.). (1994). *Sociocultural approaches to language and literacy: An interactionist perspective.* New York, NY: Cambridge University Press.

John-Steiner, V., & Souberman, E. (1978). Afterword. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind in society: The development of higher psychological processes* (pp. 121–133). Cambridge, MA: Harvard University Press.

John-Steiner, V., & Tatter, P. (1983). An interactionist model of language development. In B. Bain (Ed.), *The sociogenesis of language and human conduct* (pp. 79–97). New York, NY: Plenum Press.

Kim, J. (2006). Piagetian and Vygotskian perspectives on creativity. *Korean Journal of Problem Solving, 16*: 25–38.

Kline, S. R. (2001). *Alternative assessment of exceptional culturally and linguistically diverse students.* http://crede.berkeley.edu/research/llaa/intro6_3.html

Knox, J. E., & Stevens, C. (1993). Vygotsky and Soviet Russian defectology. In R. W. Rieber & A. S. Carton (Eds.), *The collected works of L. S. Vygotsky: Vol. 2. The fundamentals of defectology* (pp. 1–25). New York, NY: Plenum Press.

Kozulin, A. (1990). *Vygotsky's psychology: A biography of ideas.* Brighton, UK: Harvester Wheatsheaf.

Kozulin, A., Gindis, B., Ageyev, V., & Miller, S. (Eds.). (2003). *Vygotsky's educational theory in cultural contexts.* New York, NY: Cambridge University Press.

Langer, J., & Applebee, A. (1987). *How writing shapes thinking: A study of writing and teaching.* Urbana, IL: National Council of Teachers of English.

Lantolf, J. P. (Ed). (2000). *Sociocultural theory and second language learning*. Oxford, UK: Oxford University Press.

Lantolf, J. P., & Appel, G. (1994). (Eds.). *Vygotskian approaches to second language research.* Norwood, NJ: Ablex.

Lantolf, J. P., & Beckett, T. G. (2009). Research timeline: Sociocultural theory and second language acquisition. *Journal of Language Teaching, 42*(4), 459–475.

Lantolf, J. P., & Poehner, M. E. (Eds.). (2008). *Sociocultural theory and the teaching of second languages.* London, UK: Equinox.

Lantolf, J. P., & Thorne, S. L. (2006). *Sociocultural theory and the genesis of second language development*. Oxford, UK: Oxford University Press.

Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life.* Cambridge, MA: Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York, NY: Cambridge University Press.

Lee, C. (2000). Signifying in the zone of proximal development. In C. Lee & P. Smagorinsky (Eds.), *Vygotskian perspectives on literacy research: Constructing meaning through collaborative inquiry* (pp. 191–225). New York, NY: Cambridge University Press.

Lee, C., & Smagorinsky, P. (Eds.). (2000). *Vygotskian perspectives on literacy research: Constructing meaning through collaborative inquiry.* New York, NY: Cambridge University Press.

Leontiev, A. N. (1981). *Problems of the development of mind.* Moscow, Russia: Progress. (Original work published 1959)

Lidz, C. (1995). Dynamic assessment and the legacy of L. S. Vygotsky. *School Psychology International, 16*(2), 143–153.

Lima, E. (1998). The educational experience with the Tikuna: A look into the complexity of concept construction. *Mind, Culture, and Activity, 5*(2), 95–104.

Luria, A. (1973). *The working brain: An introduction to neuropsychology.* New York, NY: Basic Books.

Luria, A. R. (1975). Cognitive development, its cultural and social foundations. Cambridge, MA: Harvard University Press.

Luria, A. (1979). *The making of mind.* Cambridge, MA: Harvard University Press.

Mahn, H. (1997). *Dialogue journals: Perspectives of second language learners in a Vygotskian theoretical framework.* Unpublished doctoral dissertation, University of New Mexico, Albuquerque, NM.

Mahn, H. (1999). Sociocultural theory: Vygotsky's methodological contribution. *Remedial and Special Education, 20*(6), 341–350.

Mahn, H. (2003). Periods in child development: Vygotsky's perspective. In A. Kozulin, B. Gindis, V. Ageyev, & S. Miller (Eds.), *Vygotsky's educational theory in cultural context,* (pp. 119–137). Cambridge, MA: Cambridge University Press.

Mahn, H. (2008). A dialogic approach to teaching L2 writing. In J. Lantolf & M. Poehner, *Sociocultural theory and the teaching of second languages.* London, UK: Equinox.

Mahn, H. (2010). Vygotsky's methodological approach: Blueprint for the future of psychology. In A. Toomela & J. Valsiner (Eds.), *Methodological thinking in psychology: 60 years gone astray?* (pp. 297–323). Charlotte, NC: Information Age.

Mahn, H. (2013). Vygotsky and second language acquisition. In C. A. Chapelle (Ed.), *The encyclopedia of applied linguistics.* Oxford, UK: Wiley-Blackwell.

Mahn, H., & Bruce, M. (2010). The academic literacy for all project: A professional development model. In C. J. Casteel & K. G.

Ballantyne, (Eds.), *Professional development in action: Improving teaching for English learners.* Washington, DC: National Clearinghouse for English Language Acquisition. Available at www.ncela.gwu.edu/files/uploads/3/PD_in_Action.pdf

Mahn, H., & John-Steiner, V. (2005). Vygotsky's contribution to literacy research. In R. Beach, J. L. Green, M. L. Kamil, & T. Shanahan (Eds.), *Multidisciplinary perspectives on literacy research* (2nd ed.) Urbana, IL: National Council of Teachers of English.

Mahn, H., & Reierson, S. (2013). Research methods and sociocultural approaches in second language acquisition. In C. A. Chapelle (Ed.), *The encyclopedia of applied linguistics.* Oxford, UK: Wiley-Blackwell.

Marx, K., & Engels, F. (1976). *The German ideology* in *Collected works, Vol. 5*. New York, NY: International.

Minick, N. (1987). The development of Vygotsky's thought: An introduction. In R. W. Rieber (Ed.), *The collected works of L. S. Vygotsky: Vol. 1. Problems of general psychology.* New York, NY: Plenum Press.

Minnis, M., & John-Steiner, V. (2001). Are we ready for a single, integrated theory? Essay review of *Perspectives on activity theory* (Yrjö Engeström, Reijo Miettinen, & Raija-Leena Punamäki, Eds.). *Human Development*, *44*, 296–310.

Moffett, J. (1981). *Coming on center: English education in evolution.* Portsmouth, NH: Boynton/Cook.

Moll, L. C. (Ed.). (1990). *Vygotsky and education: Instructional implications of sociohistorical psychology.* New York, NY: Cambridge University Press.

National Research Council. (1999). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Nelson, K. (1989). Monologue as representation of real-life experience. In K. Nelson (Ed.), *Narratives from the crib* (pp. 27–72). Cambridge, MA: Harvard University Press.

Newman, D., Griffin, P., & Cole, M. (1989). *The construction zone: Working for cognitive change in schools.* Cambridge, MA: Cambridge University Press.

Newman, F., & Holzman, L. (1993). *Lev Vygotsky: Revolutionary scientist.* New York, NY: Routledge.

Novack, G. (1969). *An introduction to the logic of Marxism.* New York, NY: Pathfinder Press.

Packer, M. (1993). Away from internalization. In E. A. Forman, N. Minick, & C. A. Stone (Eds.), *Contexts for learning: Sociocultural dynamics in children's development* (pp. 254–265). New York, NY: Oxford University Press.

Panofsky, C. (1994). Developing the representational functions of language: The role of parent-child book-reading activity. In V. John-Steiner, C. Panofsky, & L. Smith (Eds.), *Sociocultural approaches to language and literacy* (pp. 223–242). New York, NY: Cambridge University Press.

Panofsky, C., John-Steiner, V., & Blackwell, P. (1990). The development of scientific concepts and discourse. In L. C. Moll (Ed.), *Vygotsky and education: Instructional implications of sociohistorical psychology* (pp. 251–267). New York, NY: Cambridge University Press.

Pea, R., Bransford, J. D., Brown, A., & Cocking, R. (2000). (Eds.). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Rivers, W. J. (1987). *Problems in composition: A Vygotskian perspective.* Unpublished doctoral dissertation, University of Delaware, Newark.

Rogoff, B. (1990). *Apprenticeship in thinking.* New York, NY: Oxford University Press.

Rogoff, B. (2003). *The cultural nature of human development.* New York, NY: Oxford University Press.

Rogoff, B., Goodman-Turkanis, C., & Bartlett, L. (Eds.). (2001). *Learning together: Children and adults in a school community.* New York, NY: Oxford University Press.

Rommetveit, R. (1985). Language acquisition as increasing linguistic structuring of experience and symbolic behavior control. In J. V. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 183–204). New York, NY: Cambridge University Press.

Rowlands, S. (2003). Vygotksy and the ZPD: Have we got it right? *Research in Mathematics Education, 5*(2), 155–170.

Sacks, O. (1989). *Seeing voices: A journey into the world of the deaf.* Los Angeles: University of California Press.

Scaife, M., & Bruner, J. (1975). The capacity for joint visual attention in the infant. *Nature, 253*, 265–266.

Schmittau, J. (1993). Vygotskian scientific concepts: Implications for mathematics education. *Focus on Learning Problems in Mathematics*, *15*, (2&3), 29–39.

Schmittau, J. (2004). Vygotskian theory and mathematics education: Resolving the conceptual-procedural dichotomy. *European Journal of Psychology of Education, 19*(1), 19–43.

Schmittau, J. (2005). The development of algebraic thinking: A Vygotskian perspective. *International Review of Mathematics Education, 37*(1), 16–22.

Schmittau, J. (2011). The role of theoretical analysis in developing algebraic thinking: A Vygotskian perspective. *Early Algebraization: Advances in Mathematics Education,* Part 1 71-85, doi: 10.1007/978-3-642-17735-4_5

Scribner, S., & Cole, M. (1981). *The psychology of literacy.* Cambridge, MA: Harvard University Press.

Shaughnessy, M. P. (1977). *Errors & expectations: A guide for the teacher of basic writing.* New York, NY: Oxford University Press.

Shonerd, H. (1994). Repair in spontaneous speech: A window on second language development. In V. John-Steiner, C. P. Panofsky, & L. W. Smith (Eds.), *Sociocultural approaches to language and literacy: An interactionist perspective* (pp. 82–108). New York, NY: Cambridge University Press.

Skeat, W. W. (1995). *Etymological dictionary of the English language.* Oxford, UK: Clarendon Press.

Smith, F. (1982). *Writing and the writer.* Hillsdale, NJ: Erlbaum.

Stetsenko, A., & Arievitch, I. (2002). Learning and development: Post-Vygotskian perspectives. In G. Wells & G. Claxton (Eds.), *Learning for life in the 21st century: Sociocultural perspectives on the future of education* (pp. 84–96). Cambridge, MA: Blackwell.

Sutton, A. (1980). Backward children in the USSR. In J. Brine, M. Perrie, & Andrew Sutton, (Eds.), *Home, school and leisure in the Soviet Union* (pp. 160–191). St. Leonards, Australia: Allen & Unwin.

Taylor, D. (1998). *Beginning to read and the spin doctors of science: The political campaign to change America's mind about how children learn to read.* Urbana, IL: National Council of Teachers of English.

Tchoshanov, M., & Fuentes, C. (2001, May–June). *Cognition, visualization, and technology: In-depth learning of mathematics*. Paper presented at the Annual Meeting of the NMMATYC. Albuquerque, NM.

Tharp, R., Estrada, P., Dalton, S. S., & Yamuchi, L. A. (2000). *Teaching transformed: Achieving excellence, fairness, inclusion and harmony.* Boulder, CO: Westview Press.

Tharp, R. G., & Gallimore, R. (1988). *Rousing minds to life: Teaching and learning in social context.* New York, NY: Cambridge University Press.

Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.

Tomasello, M. (2008). *Origins of human communication*. Cambridge, MA: MIT Press.

Toomela, A. (2003). (Ed.). *Cultural guidance in the development of the human mind.* Westport, CT: Ablex.

Torres-Velásquez, D. (Ed.). (1999). Sociocultural perspectives in special education. *Remedial and Special Education, 20*(6), 321–384.

Torres-Velásquez, D. (Ed.). (2000). Sociocultural perspectives in special education. Part 2. *Remedial and Special Education, 21*(2), 65–128.

Towsey, P. (2009). Wolves in sheep's clothing and other Vygotskian constructs. *Mind, Culture, and Activity: An International Journal, 16*(3), 234–263.

Van der Veer, R., & Valsiner, J. (1991). *Understanding Vygotsky: A quest for synthesis.* Cambridge, MA: Blackwell.

Van der Veer, R., & Valsiner, J. (Eds.). (1994). *The Vygotsky reader.* Cambridge, MA: Blackwell.

Van Oers, B. (1999). Quality of diagnostic teaching abilities in early education. *European Early Childhood Education Research Journal, 7*(2), 39–51.

Van Oers, B. (2011). *On the narrative nature of young children's iconic representations: Some evidence and implications.* http://webpages.charter.net/schmolze1/vygotsky/

Vygotskaya, G. (1999). On Vygotsky's research and life. In S. Chaiklin, M. Hedegaard, & U. J. Jensen (Eds.), *Activity theory and social practice* (pp. 31–38). Oakville, CT: Aarhus University Press.

Vygodskaya, G. L., & Lifanova, T. M. (1999a). Part 1: Life and works of L. S. Vygotsky. *Journal of Russian and East European Psychology, 37*(2), 23–81.

Vygodskaya, G. L., & Lifanova, T. M. (1999b). Part 1: Life and works of L. S. Vygotsky (cont.). *Journal of Russian and East European Psychology, 37*(3), 3–31.

Vygodskaya, G. L., & Lifanova, T. M. (1999c). Part 2: Through the eyes of others. *Journal of Russian and East European Psychology, 37*(3), 32–90.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1981). The instrumental method in psychology. In J. V. Wertsch (Ed.), *The concept of activity in Soviet psychology.* Armonk, NY: Sharpe.

Vygotsky, L. (1986). Thought and language. (A. Kozulin, Ed.) Cambridge, MA: MIT Press.

Vygotsky, L. S. (1987). *The collected works of L. S. Vygotsky: Vol. 1. Problems of general psychology* (R. W. Rieber & A. S. Carton, Eds.). New York, NY: Plenum Press.

Vygotsky, L. S. (1993). *The collected works of L. S. Vygotsky: Vol. 2. The fundamentals of defectology (abnormal psychology and learning disabilities).* (R. W. Rieber & A. S. Carton, Eds.). New York, NY: Plenum Press.

Vygotsky, L. S. (1994). The problem of the environment. In R. Van der Veer & J. Valsiner (Eds.), *The Vygotsky reader* (pp. 338–354). Cambridge, MA: Blackwell.

Vygotsky, L. S. (1997). *Educational psychology.* Jamaica Hills, NY:Saint Lucie Press. (Original work published 1926)

Vygotsky, L. S. (1997a). *The collected works of L. S. Vygotsky: Vol. 4. The history of the development of higher mental functions* (R. W. Rieber, Ed.). New York, NY: Plenum Press.

Vygotsky, L. S. (1997b). The historical meaning of the crisis in psychology: A methodological investigation. In R. W. Rieber & J. Wollock (Eds.), *The collected works of L. S. Vygotsky: Vol. 3. Problems of the theory and history of psychology* (pp. 233–343). New York, NY: Plenum Press.

Vygotsky, L. S. (1998). *Child psychology. The collected works of L. S. Vygotsky: Vol. 5. Problems of the theory and history of psychology.* New York, NY: Plenum Press.

Wells, G. (1999). *Dialogic inquiry: Toward a sociocultural practice and theory of education.* New York, NY: Cambridge University Press.

Wells, G., & Claxton, G. (Eds.). (2002). *Learning for life in the 21st century: Sociocultural perspectives on the future of education.* Cambridge, MA: Blackwell.

Wenger, E. (2011). Communities of practice: A brief introduction. www.ewenger.com/theory/index.htm

Wertsch, J. V. (1985a). *Vygotsky and the social formation of mind.* Cambridge, MA: Harvard University Press.

Wertsch, J. V. (Ed.). (1985b). *Culture, communication, and cognition: Vygotskian perspectives.* New York, NY: Cambridge University Press.

Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action.* Cambridge, MA: Harvard University Press.

Wertsch, J. V., & Stone, C. A. (1985). The concept of internalization in Vygotsky's account of the genesis of higher mental functions. In J. V. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 162–179). New York, NY: Cambridge University Press.

Wineburg, S. (1997). T. S. Eliot, collaboration, and the quandaries of assessment in a rapidly changing world. *Phi Delta Kappan, 78*(1), 59–65.

Winsler, A., Fernyhough, C., & Montero, I. (Eds.). (2009). *Private speech, executive functioning, and the development of self-regulation.* New York, NY: Cambridge University Press.

Wong-Fillmore, L. (1985). When does teacher talk work as input? In S. M. Gass & C. G. Madden (Eds.), *Input in second language acquisition: Series on issues in second language research* (pp. 17–50). Rowley, MA: Newbury House.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100.

Yaroshevsky, M. (1989). *Lev Vygotsky.* Moscow, Russia: Progress.

Yaroshevsky, M. G., & Gurgenidze, G. S. (1997). Epilogue. In R. W. Reiber & J. Wollack (Eds.), *The collected works of L. S. Vygotsky: Vol. 3. Problems of theory and history of psychology* (pp. 345–369). New York, NY: Plenum Press.

Zebroski, J. T. (1994). *Thinking through theory: Vygotskian perspectives on the teaching of writing.* Portsmouth, NH: Heinemann.

Zukow-Goldring, P., & Ferko, K. R. (1994). An ecological approach to the emergence of the lexicon: Socializing attention. In V. John-Steiner, C. P. Panofsky, & L. W. Smith (Eds.), *Sociocultural approaches to language and literacy: An interactionist perspective* (pp. 170–190). New York, NY: Cambridge University Press.

CHAPTER 7

Moral-Character Education

DANIEL K. LAPSLEY AND DAVID YEAGER

MORAL-CHARACTER EDUCATION

This chapter addresses one of the foundational issues that confront parents and educators: What is to be done about the moral character formation of children? Few would doubt that raising children of strong moral character is a highly desirable goal for socialization. Most parents would be disappointed if their children entered adulthood with only slight acquaintance with moral norms, dispositions, or emotions, or evinced these qualities only on occasion. But not only parents. The development of moral character is also a broadly shared goal that animates the work of socialization agents in every contextual setting that involves children, including schools and churches, youth organizations and other community institutions. Indeed, the concern over the proper induction of the younger generation by the older into the norms and canons of good conduct is probably a universal of the human experience.

Yet the terms of reference for moral character education (MCE) are broadly contested whatever the basic agreement on the desirability of its goals (Goodman & Lesnick, 2001). Historically, the terms *moral education* and *character education* have pointed to different psychological traditions, ethical theories, curricular objectives, and pedagogical preferences. Whether one is a moral educator or a character educator is thought to reveal something about one's paradigmatic allegiances, about where one stands in terms of certain defining issues that sorts one into rival camps, with each camp having its own professional society (e.g., Association for Moral Education, the Character Education Partnership) and professional journal (e.g., *Journal of Moral Education*, *Journal of Research in Character Education*). We consider these distinctions in the present chapter. Our own perspective is that there is now more consensus than controversy, that paradigmatic allegiances are held without the same fervor as before, and that a reasonable middle way between camps is a realistic option (Lapsley & Narvaez, 2006). Our title elides the paradigmatic divide and reflects this optimism about finding common ground.

But what counts as moral or character education? As we see, the boundaries of our topic are not easy to map. Moral character education can be expansive or non-expansive (Kristjansson, 2002), broad or narrow (Lapsley & Narvaez, 2006), traditional or progressive (Wynne, 1997). Although it is often conceived as something that takes place in schools, how it plays out within families and communities is also a concern (Berkowitz, Vincent, & McKay, 2002; Hart, Matsuba, & Atkins, 2008; Lies, Bronk, & Mariano, 2008). The purpose of moral character education is also contested. For some educators, MCE is a prophylaxis against the rising tide of youth disorder and is motivated by deep anxiety about adolescent risk behavior, misconduct, and delinquency (Brooks & Goble, 1997; Lickona, 1991; Wynne & Hess, 1992). For others, MCE is closely aligned with positive youth development, which aims for the full preparation of all youth, not just those at risk for problem behavior (Berkowitz, Sherblom, Bier, & Battistich, 2006; Catalano, Hawkins, & Toumbourou, 2008). Risk free is not fully prepared is the motto of this movement (Roth & Brooks-Gunn, 2003).

How MCE aligns with classroom instructional or academic goals also varies considerably (Stengel & Tom, 2006). There are issues concerning effective implementation of MCE programs and of its connection to wide-ranging educational purposes, including early education (Berkowitz & Grych, 2000) civics education (Berkowitz, 2000) and science (Berkowitz & Simmons, 2003) education, among others; and concerns about how to prepare preservice and in-service teachers for their role as moral character educators (Berkowitz, 1999; Narvaez & Lapsley, 2008; Schwartz, 2008). How to understand moral character formation in sports (Power, Sheehan, & Carnevale, 2010; Shields & Bredemeier, 2005, 2008), the university (Brandenberger, 2005; Colby, Ehrlich, Beaumont, & Stephens, 2003) and professions (Bebeau & Monson, 2008) are also important areas of study.

In this chapter we begin with some orienting assumptions about the nature of moral character and the place of values in the daily life of schools. We then compare and contrast the two dominant paradigms along several dimensions but with the aim of arriving at a middle way. In the third section, we examine three general theoretical approaches to MCE, including moral stage and domain theory and the recent interest in moral self-identity as an educational goal. In the fourth section, programmatic approaches to MCE are reviewed with the aim of determining "what works." A discussion of delivery mechanisms and implementation issues are taken up in the fifth section. We conclude with a reflection on the implications of these literatures for parent and teacher education.

MORAL-CHARACTER EDUCATION: ASSUMPTIONS AND PARADIGMS

The history of American education reveals intense but periodic interest in MCE (McClellan, 1999). There are at least two ways to read this history. On one account there was a halcyon golden age when character education in public schools was intentional, pervasive, and unproblematic. However, public schools later retreated from character education as a result of broad changes in science, society and culture, with disastrous consequences for the well-being of youth and society.

Lickona (1991) noted four broad trends: (1) Darwin's theory of evolution uprooted the notion that traditional morality was fixed, static and unchanging; (2) Einstein's theory of relativity encouraged the view that moral claims might be relative to certain points of view; (3) Hartshorne and May's (1928–1930) classic research on character traits in schools showed that students' ethical behavior was highly situation-dependent; (4) and the general rise of logical positivism encouraged the view that the only sensible things to say were those amenable to publicly verifiable empirical demonstrations (as "facts"), while everything else ("values") was held to be subjective, personal and quite literally "non-*sense*" (see, e.g., Ayer, 1952).

For Lickona (1991) these four trends put intentional character education on the defensive. "When much of society," he writes, "came to think of morality as being in flux [Darwin], relative to the individual [Einstein], situationally variable [Hartshorne and May] and essentially private [logical positivism], public schools retreated from their once central role as moral educator" (p. 8). Along similar lines, Kristjansson (2002) points to a crumbling of a belief in direct moral-character formation in schools, leading to moral concerns being sidelined "from mainstream educational discourse in the Western world and marginalizing, if not wholly extirpating, references to the cultivation of character of children via school curricula and other school processes" (p. 136).

A second reading also tracks the rise and fall of character education but with a different diagnosis. Cunningham (2005) argued that the periodic rise of character education in U.S. history was often accompanied by periods of cataclysmic change in U.S. society, when there were profound challenges to national identity and widespread anxiety about the unsettling forces of modernity. But this interest was hard to sustain in the absence of an adequate character psychology to guide curricular intervention and instructional practice. According to Cunningham, "Unless psychology can provide a better model of human development . . . character will continue to receive sporadic and faddish treatment and the public's common school will continue to be undermined" (p. 197). The closer alignment of the ethical conceptions of moral character with advances in the cognitive, developmental, and personality sciences is a decided recent trend that should hold promise for educational intervention.

The two readings of the history of character education suggest two issues. The first concerns the place of values and morality in U.S. classrooms; the second concerns how best to conceptualize character. We next sketch our working assumptions on these two issues.

Immanence and Inevitability

It should not be supposed that even during periods when MCE was said to have been stricken from U.S. schools or fallen out of favor that values education was ever absent from classrooms and schools. There is no such thing as values-free education. Moral values saturate the daily life of classrooms and schools (Bryk, 1988; Goodlad, 1992;

Strike, 1996). Moral values are embedded inextricably in the "hidden curriculum" of instructional practice—in the topics chosen (or excluded) for instruction; in the demand for truth and excellence, good effort and mastery; in the way teachers establish classroom routines, form groups, enforce discipline; and in the way students experience community and school membership. It is intrinsic in the notion of what it means to develop, to set goals, and to aspire to achieve them (Carr, 1991). As ethicist Richard Baer (1993, p. 15) put it, "Every curriculum that is more than simple technical instruction rests on fundamental understandings and commitments regarding the nature of reality itself, the nature of the good life and the good society, and how one ought to live." In these ways character formation is intrinsic to classrooms and an inescapable part of the educator's craft (Hansen, 1993; Jackson, Boostrom, & Hansen, 1993).

The *immanence* of values and the *inevitability* of moral education are embedded deeply in the life of classrooms and schools. Moreover, the immanence-and-inevitability of MCE would seem to arm the character educator with all the resources that are needed to defend an intentional and transparent commitment to the moral formation of students. The case is made by pointing to the fact that moral considerations are immanent to the life of classrooms and schools; that teaching and learning are value-laden activities; that moral aims are intrinsic to education. Making the case implies that it is unacceptable to allow the immanence-and-inevitability of character education to remain part of a school's *hidden* curriculum. If character education is hidden it cannot be tended properly. The value commitments immanent to education must be transparent and the object of intentional instruction (Rivers, 2004).

Stengel and Tom (2006) define morality broadly as that which concerns *right relationship* and that which is *worth doing*. As such, moral language is found pervasively in classrooms and schools. It is found routinely in the conversations between teachers and students, as in the following examples (p. 25):

"Please show respect for the person who is speaking by listening carefully and then responding."
"Why did the settlers treat the Indians that way? It doesn't seem fair."
"Boys and girls, this is a wonderful story about friendship, isn't it?"
"Mrs. Quinn, Brendan is pulling my hair."
"Whose responsibility is it to clean up the lab?"

This is moral language because it implicates *right relation* or something *worth doing*. These are examples of the way that morality is immanent in the daily life of schools; and is so pervasive and prosaic that one hardly notices it. It is hidden because it is common and in plain sight. Contrast moral language with what Stengel and Tom (2006) call language *about* morality. Here are their examples:

"Whose morals?"
"There hasn't been any morality in schools since prayer was banished."
"Kids today need character. They are not getting it at home."
"Discipline is the key to effective schooling."
"Our policy is zero tolerance."

Moral language—the language of right relation and what is worth doing—has never been absent in schools and continues apace irrespective of the language about morality that waxes and wanes with the rise and fall of paradigmatic commitments. But moral language is not easy to speak. Ethical theory is multiform and divided. There are moral dialects that strain fluency and comprehension (MacIntyre, 1981). We examine some of the implications of moral language for understanding MCE below, but first we turn to the second issue revealed by the history of MCE, which is how to understand character.

Character Psychology

The word character is derived from a Greek word meaning *to mark* as on an engraving. One's character is said to indicate something about consistency and predictability; an enduring dispositional tendency to behave in certain ways. There are many definitions. Character refers to good traits that are on regular display (Wynne & Ryan, 1997); to sets of habits that "patterns our actions in a relatively fixed way" (Nicgorski & Ellrod, 1992, p. 143); to a "relatively settled general disposition of a person to do what is morally good," where the general disposition can be analyzed into traits or virtues that hang together in certain ways (Davis, 2003, p. 33); to a general approach to social dilemmas, a capacity for empathy, self-discipline and the acquisition of prosocial skills and knowledge about conventions and values (Etzioni, 1996; Hay, Castle, Stimson, & Davies, 1995). Davidson, Lickona, and Khmelkov (2008) distinguish between performance character as a mastery orientation required for excellent performance (e.g., diligence, perseverance, work ethic, positive attitude) and moral character as a relational orientation needed for interpersonal relationships and good conduct (e.g., integrity, respect, justice, caring, responsibility). Berkowitz (2002, p. 48) defines character as "an individual's set of psychological characteristics that affect that person's ability and inclinations to function morally." Seven psychological characteristics make up the "moral anatomy": moral behavior, moral values, moral personality, moral emotion, moral reasoning, moral identity, and other foundational characteristics that support moral functioning.

Clearly, character is a complex construct that includes traits, habits, and virtues organized into a "complex constellation of psychological dimensions of a person" (Berkowitz, 2002, p. 49). One difficulty is that these descriptors carry a heavy semantic load that is not easily reconciled. Virtues, for example, are ethical concepts that have no particular traction in psychological science unless they are conceptualized as traits or habits. Traits and habits are dispositional terms that do not have straightforward or uniform psychological meaning. If character refers to the moral qualities of personality, then its explication for purposes of character education will require an account that is compatible with the best insights about psychological functioning and with well-attested models of personality. It will require an account of character that is mindful of its developmental contours (Sokol, Hammond, & Berkowitz, 2010).

Habits, for example, have strong appeal to character educators. Habits are sometimes used as synonyms for virtues and vices, as in the claim that "character is the composite of our good habits, or virtues, and our bad habits, or vices" (Ryan & Bohlin, 1999, p. 9). Persons of good character behave well without much temptation to do otherwise and without much conscious deliberation: "They are good by force of habit" (Ryan & Lickona, 1992, p. 20). This view of habits has important classical sources. In the *Nichomachean Ethics* Aristotle defines the nature of virtues in terms of habituation. On his account we acquire virtues by exercising them. We learn what virtue requires by acting virtuously. One must practice the good if one is to understand the good.

This formulation has invited attempts to understand virtues-as-habits in terms that are compatible with contemporary moral psychology. For example, Steutal and Spiecker (2004) argue that Aristotelian habituation is best understood as a learning-by-doing with regular and consistent practice under the guidance and authority of a virtuous tutor. The habits that emerge from coached practice are settled dispositions to do certain kinds of things on a regular basis but automatically, without reflective choice, deliberation or planning (Steutal & Spiecker, 2004). Social cognitive accounts of moral personality understand the settled dispositions of habits and virtues in terms of social cognitive units (schemas, prototypes, scripts) that are progressively elaborated as a result of repeated experience, instruction and socialization (Lapsley & Narvaez, 2004).

Similarly, Narvaez (2005) argues that the formation of moral character is similar to expertise and skill development. Character development, on her account, is a matter of perfecting component skills to higher level of expertise. Indeed, that virtues are usefully conceptualized as skills is an argument also made increasingly by virtue theorists (Annas, 2011; Jacobson, 2005; Stichter, 2007a, 2007b). Moreover, with coached practice of any skill there develops an increasing intuitive responsiveness that permits rapid, automatic judgments, or behavioral responses to relevant contingencies (Bartsch & Wright, 2005). This would seem to account for the tacit qualities often associated with Aristotelian "habits." The moral habits of virtue theory are social cognitive schemas or behavioral skills whose frequent activation becomes overlearned to the point of automaticity (Lapsley & Hill, 2008).

Paradigms

For the past few decades moral-character education was bifurcated into two traditions, one of moral (ME) and the other of character education (CE). The two traditions are paradigmatic in the sense that each seemed organized around a cluster of related beliefs, commitments, and preferences that are difficult to reconcile. For example, ME and CE orient toward different ethical theories, preferred educational strategies and traditions of liberal education. Table 7.1 summarizes the differences between ME and CE with respect to ethical theory (following G. Watson, 1990).

Moral education fashioned around Kantian deontology is one that emphasizes the primacy of reason, judgment, and decision making. The goal of ME is to cultivate

TABLE 7.1 Underlying Ethical Theory for Moral and Character Education

	Moral Education	Character Education
Ethical theory	Ethic of obligation (Kant)	Ethic of virtue (Aristotle)
Key question	What ought I to do? What is my duty? What does the moral law require?	What sort of person should I become?
Basic moral facts	Judgments of obligation	Qualities of character
What is appraised?	Conduct—what should I do?	Agents—who/what should I be?
What to cultivate?	Decision making and reasoning	Habits, traits, virtues

powers of reasoning so that one better apprehends what the moral law requires; so that one better knows what one is obliged to do given the exigencies of the case. In contrast CE is aligned with Aristotelian concerns to develop virtuous traits that conduce to living well the life that is good for one to live. Whereas ME emphasizes the development of reasoning so as to determine what is to be done, CE emphasizes the cultivation of habits and dispositions that allow agents to flourish.

The two paradigms also have preferred pedagogical strategies. Moral education encourages students to actively construct moral meaning by discussion of dilemmas and by engaging in democratic classroom practices that requires the consideration of multiple social perspectives. There are class meetings to discuss rules, infractions, and other occasions of joint decision making. The goal of dialogical social interaction is to encourage a sense of genuine community and positive moral climate whereby students take responsibility for doing good and respecting others (Power, Kohlberg, & Higgins, 1989). Character education, at least traditional character education, does not see the point of this and endorses instead authoritative exhortation of the great tradition or direct instruction about favorite virtues (Wynne, 1997).

Finally, the two paradigms reflect competing options revealed by the history of liberal education. Kimball (1986) argued that liberal education has alternated since antiquity between two distinct traditions, what he called the *philosophical* and *oratorical* traditions. Table 7.2 is a summary of key distinguishing features of these traditions, with ME and CE aligning with the philosophical and oratorical traditions, respectively (following Kimball, 1986).

The philosophical tradition wants to equip students with the philosophical capacities to reason critically, judge fairly and with an open mind, just because truth is elusive, the future is uncertain and complexities are many. We see through the glass darkly but truth wins out by disciplined philosophical inquiry. The oratorical tradition, in contrast, aims to expose students to classical texts and the wisdom of traditions. One becomes a citizen-orator by acquaintance with the rhetoric of the classics. Truth and goodness is not so much discovered by philosophical inquiry but recovered in the great texts that provide a foundation for the way forward. Kimball (1986) argued that most of the educational controversies of the past century reflect the ongoing debate between these two traditions. Educational reform oscillates between these traditions. Every step toward progressive innovation is followed by retrenchment to basics so that we keep recycling the same set of educational reforms.

TABLE 7.2 Traditions of Liberal Education

Philosophical Tradition	Oratorical Tradition
Truth is unsettled and elusive	Truth is found in the great texts and traditions
The search for truth is an act of discovery	The search for truth is an act of recovery
Education equips for an uncertain future	Education equips with certain verities of the past
Strong on method (Weak on content)	Strong on content (Weak on method)
Moral Education	Character Education

The ME and CE paradigms would seem to align with the philosophical and oratorical traditions of liberal education, respectively. Moreover, the two traditions pick up pedagogical preferences for direct (oratorical) and indirect (philosophical) methods. Dewey (1908) defined the debate in this way. It "may be laid down as fundamental," he asserted, "that the influence of direct moral instruction, even at its very best, is *comparatively* slight in influence" (p. 4). Dewey was critical of traditional pedagogies of exhortation, didactic instruction and drill, practices that reduces moral instruction to teaching *about* virtues or instilling certain attitudes in students. Instead what is required is an approach to moral education that links school subjects to a social interest; that cultivates children's ability to discern, observe, comprehend social situations; that uses methods that appeal to the "active constructive powers" of intelligence; that organizes schools along the lines of a genuine community. This vision of Dewey's is sometimes called a *progressive* or *indirect* approach because it eschews didactic instruction and direct transmission of moral content in favor of approaches that emphasize the child's active construction of moral meaning through participation in democratic practices, cooperative groupings, social interaction and moral discussion (DeVries & Zan, 1994).

It would seem, then, that debates about the relative merits of CE and ME and direct and indirect methods of instruction reflect much deeper and longer-standing tensions between philosophical and oratorical traditions of liberal education. Featherstone (1986) pointed out that the great strength of the philosophical tradition (ME) is its emphasis on the free exercise of reason in the pursuit of truth, but its weakness is its relative silence on just what is to be taught. It is strong on *how* to teach, it is strong on method, but it is weak on *what* to teach, or content. The oratorical tradition, in turn, has no difficulty with what to teach or the content of instruction—one transmits the classic texts of the great tradition. In the oratorical tradition the goal is to impart the truth not to help students seek it. But herein is its weakness, for the oratorical tradition is strong on content but weak on method. It embraces a set of pedagogical strategies that are ineffective on the evidence of contemporary research in the educational sciences (e.g., Anderson, 1989).

Although these distinctions have considerable heuristic value it is not difficult to see the middle way. For example, with respect to pedagogy our best teachers combine direct and indirect methods and are expert in what Shulman (1987) termed "pedagogical content knowledge" that allow them to map appropriate methods to specific content. As Kristjansson (2002, p. 139) put it, "Let us use as many strategies as necessary to make students smart and good." The best approaches to moral-character education will flexibly balance philosophical methods of inquiry with oratorical respect for tradition and text. We need both philosophers and orators in moral-character education (Lapsley & Narvaez, 2006).

Moreover, the distinction between Kantian and Aristotelian ethical theory should not be overemphasized. These formidable ethical frameworks are not entirely incommensurable (Sherman, 1997). In some ways Kant, too, was a virtue theorist, and virtue theory can yield action-guiding prescriptions just like Kantian deontology (Hursthouse, 1999). Paradigmatic distinctions also break down in actual practice. Although Aristotelian virtue theory may inspire the modern resurgence of character education, that does not stop character educators from being just as concerned about right conduct and good judgment as any good deontologist. What's more, some approaches to character education work both sides of the paradigmatic divide. For example, Thomas Lickona endorses a model of CE that that has clear oratorical sympathies that supports direct advocacy of basic, core values, yet also endorse indirect strategies as well, including cooperative learning, conflict resolution, classroom democratic practices, moral discussion and the need to build a moral community within classrooms and schools (Lickona, 1997; Lickona & Davidson, 2004).

Boundary Issues

Although paradigmatic distinctions are porous it is not always easy to determine what is to count as MCE. McLaughlin and Halstead (1999) distinguish between CE that is expansive and nonexpansive. Nonexpansive CE consists of programs that have a specific overriding justification (e.g., arresting the cultural decline of society), with a focus on teaching core universal values and developing moral habits. In contrast, expansive CE has broader purposes (e.g., civic education), with a focus on a range of adaptive dispositions beyond a basic core while emphasizing moral reasoning, discussion, and community (rather than habit-training). In some ways this restates the paradigmatic distinction between ME and CE noted earlier.

Kristjansson (2002) argued that there are forms of nonexpansive CE worth defending, such as Lickona's approach. For Kristjansson a defensible nonexpansive form of CE must have at least two features: (a) it must commit to moral cosmopolitanism and (b) to methodological substantivism. Moral cosmopolitanism is the view that there are transcendental moral values that anyone, in any society, in any time or place, could identify; and that these basic moral universals should be the target of intentional character education. Methodological substantivism holds that "the content of the moral truths that are transmitted to students in character education is more important that the process or method by which they are taught" (Kristjansson, 2002, p. 139). Nonexpansive CE, on these two criteria, is distinguished by a commitment to teach a basic set of core moral values by whatever means that is shown to work.

Lapsley and Narvaez (2006) drew a somewhat related distinction between broad and narrow CE; and CE conceived as a treatment or an outcome. Often the case for CE is made on the basis of troubling epidemiological trends on adolescent risk behavior. This way of framing CE is so common that it is almost a literary genre. Character education is needed because there is an epidemic of poor academic achievement, school-dropout, cheating, premarital sex, adolescent pregnancy, and substance use. Adolescents are showing disrespect, using bad language, attempting suicide, and engaging in many other forms of irresponsible behavior (Brooks & Goble, 1997). Presumably these risk behaviors bear the mark of poor moral character. Consequently, any program that drives down these trends, that is, programs that encourage school persistence, improve social skills, discourage the use of drugs and alcohol, and prevent sexual activity and pregnancy, and so on, might qualify as a moral education program. Indeed, Berkowitz and Bier (2004) identified 12 recommended and 18 promising practices for CE. These practices covered a wide range of purposes, including health education, problem solving, life-skills training, and positive youth development, among others. Yet the language of morality, virtue and character was largely absent from this literature, nor were the various programs described as instances of MCE. But the success of these programs is claimed as a vindication of CE nonetheless because “they are all school based endeavors designed to help foster the positive development of youth” (Berkowitz & Bier, 2004, p. 5). We take up this issue later when we consider “what works” in MCE.

Should CE include health promotion and risk reduction programs? Do school-based interventions of any kind count as CE so long as they yield positive outcomes for youth? The trouble with such a broad conception of MCE is that it does not point to anything distinctive by way of treatment. In the broad sense moral character education might refer to any program that prevents risk behavior or promotes resilience in the case of risk exposure. Of course, these interventions are driven by constructs, theories, and literatures (e.g., developmental psychopathology, risk-and-resilience) that make no reference to morality, virtues, or character; and the only reason to treat them as instances of MCE at all is because they reduce or prevent problematic behaviors associated with the “rising tide of youth disorder” so commonly thought to reflect the absence of character education in the schools.

But if character education is all of these things then the singularity of CE as an educational program with a distinctive purpose is lost. It becomes instead a catalog of psychosocial interventions and risk prevention programs whose objectives are framed by an entirely different set of theoretical literatures that make no reference to morality, virtue, or character. Indeed, “there is little reason to appeal to character education, or use the language of moral valuation, to understand the etiology of risk behavior or how best to prevent or ameliorate exposure to risk or promote resilience and adjustment” (Lapsley & Narvaez, 2006, p. 259).

In the narrow sense MCE has a chiefly moral purpose oriented around fundamental values. It aims to influence children’s capacity or inclination for moral judgment, behavior, or emotion. We engage in MCE to inculcate virtues or to orient the dispositional qualities of youngsters toward morally desirable aims for normatively laudable reasons. Hence, to justify MCE in the narrow sense would seem to require facility with ethical theory or require some conception of how practice conduces to the formation of virtuous dispositions. In a previous review we were critical of such an expansive view of CE, and suggested that a program or intervention must have something about morality in the *treatment* if its good outcomes are to be claimed as vindication for MCE (Lapsley & Narvaez, 2006). That said, while it may be controversial to treat school-based prevention programs (e.g., for pregnancy, substance use, violence) as examples of MCE, it may be the case that competent behavior hangs together as a cluster much the way that problem behavior does, and that all good causes in education, whether it be moral character formation or risk reduction, come down to a common set of instructional practices. In this case it might not matter much if this practice is apportioned to MCE and that one to developmental psychopathology (Berkowitz, Battistich, & Bier, 2008).

So a broad conception of CE links it to any school-based regimen that has positive outcomes. It is agnostic about the treatment, that is, the form of the intervention or its purpose, but claims the outcome for itself. A narrow CE, in contrast, would look like the nonexpansive CE defended by Kristjansson (2002). It would be an educational intervention that was sure of its treatment (teaching basic core values as befitting moral cosmopolitanism) and sure of its outcomes (moral or prosocial behavior) but agnostic about methods (as befitting methodological substantivism).

In the remainder of this chapter we review some general approaches to MCE. As noted earlier, however, the tension between expansive and nonexpansive MCE makes it difficult to draw a boundary between what is distinctly the purview of MCE or developmental psychopathology or ordinary best practice instruction. In the next section we take up various theoretical approaches that have guided research on MCE.

THEORETICAL APPROACHES

Three contemporary theoretical approaches have important implications for MCE. Moral stage theory, the domains approach to social reasoning, and a more recent approach that focuses on moral self-identity each propose strategies for advancing socio-moral development.

Moral Stage Theory

For several decades the field of moral education was dominated by the cognitive developmental approach to socialization pioneered by Lawrence Kohlberg (1969). According to Kohlberg, the form or structure of moral reasoning undergoes a series of developmental transformations as one moves from late childhood to early adulthood. These transformations are described in terms of six stages that gradually reveal, at the highest stages, an increasingly sophisticated appreciation of the moral point of view. The sequence of stages is held to be universal, invariant, and descriptive of qualitative changes in justice reasoning (about fairness). Furthermore, developmental progression through the stages is said to reflect not only advances in cognitive operations such as perspective taking, but also an advance in the quality of moral reflection as well. Reasoning at the highest stages is both psychologically sophisticated and morally adequate, with moral adequacy judged by how well reasoning aligns with moral philosophic criteria. By explicitly appealing to certain ethical principles (e.g., Kant's categorical imperative) and by engaging in one of several dilemma-solving tactics (e.g., reasoning from the original position, appealing to procedural justice checks on the validity of reasoning), one increases the likelihood that just solutions will be found that command consensus because of its evident rationality.

Kohlberg (1987, p. 300) argued, "The most important validity criterion of a stage test is evidence for it meeting the criterion of invariant sequence." This implies no stage skipping and no stage regression. The second most important criterion is "structured wholeness." This implies that reasoning across different kinds of moral dilemmas should coalesce around the same stage. On one account the results of validation research (e.g., Colby, Kohlberg, Gibbs, & Lieberman, 1983) were said to be "spectacular" (Rest, 1985, p. 466). Yet research has also shown that progress through the stages is glacial, and that the incidence of principled reasoning at the highest stage is so rare that it was dropped from the scoring manuals. And not all the evidence was supportive. Kohlberg's own research team uncovered evidence of stage regression and moral reasoning so heterogeneous across different types of dilemmas that doubts were raised about the validity of the stage model (see Lapsley, 2008, for a review).

So although the empirical status of the moral stage theory was at the center of robust debate it also presented with attractive educational implications (Snarey & Samuelson, 2008). For example, Blatt and Kohlberg (1975) argued that pitching moral arguments one stage above a student's current level of reasoning could induce movement in the direction of the next highest stage. This technique became known as the *plus-one convention* (or the *Blatt effect*) and it generated widespread use of classroom dilemma-discussion as a prototypic moral education strategy (Blatt & Kohlberg, 1975). Discussion of moral dilemmas was most effective when it induced cognitive conflict and disagreement and when arguments were within a stage (possibly just half stage) of students' general level of moral understanding (Schaefli, Rest, & Thoma, 1985). This optimal range of stage disparity is probably within reach of well-led class discussions and no special stage tracking by teachers is required (Berkowitz, Gibbs, & Broughton, 1980). But the quality of discussion matters as much as its stage content. For example, discussion that is transactive, that is, discussion that operates on the reasoning of another by extending its logic, undermining its claims, integrating its perspective, and so on, is the engine that drives moral development (Berkowitz & Gibbs, 1983; Lapsley, Enright, & Serlin, 1989).

In addition to student discussion of topical moral dilemmas the Kohlberg team also encouraged schools to engage students in democratic practices that would establish and defend shared normative expectations and adjudicate conflict (Power, Higgins, & Kohlberg, 1989). Kohlberg was inspired by Durkheim's (1925) view that groups take on emergent properties that are not the mere sum of group members; and that groups are the primary context for socialization. Groups create and sustain a moral culture that influences how individuals understand rules and norms. Hence, moral education for Kohlberg and his team was not simply a matter of increasing the decision-making competence of adolescents, but also required transforming schools into communities where justice permeates the moral atmosphere (Kohlberg, 1985, 1987).

The chief mechanism for effecting school-wide change in moral atmosphere is to give students a stake in the conduct of the school. In three schools the Kohlberg team pioneered an intervention that involved weekly meetings to discuss norms, rules, and infractions. Students and parents were put on important committees and there was broad collaboration among educators, students, and parents that aimed for consensus and democratic participation. The strategy follows Dewey's 1908 instruction that "The only way to prepare for social life is to engage in social life" (p. 15); and that the school has no moral aim apart from participation in the "agencies, instrumentalities and materials of school life" (p. 15). The school must become an "embryonic typical community" where democratic practices sharpen the "vital moral education" required for participation in larger society.

Hence the just community approach combines Durkheim's views on the power of group socialization with Dewey's conception of democratic participation as the lever of meaningful moral education. It was informed also by Piaget's (1932) views concerning the development of autonomous morality within a society of equals. The developmental flavor is captured by three underappreciated constructs that Power, Higgins, and Kohlberg (1989) introduced in their seminal investigation to map the transformation of school culture: *level of institutional valuing*, *stages of community valuing*, and *phases of the collective norm*.

Level of institutional caring charts the degree to which students value their school as an institution. At Level 0 ("Rejection") the school is not valued; at Level 1 ("Instrumental Extrinsic Valuing") the school is valued to the extent it meets a student's needs; at Level 2 ("Enthusiastic Identification") the school is valued at special moments when students feel particularly identified with the school; at Level 3 ("Spontaneous Community") the school is valued as a place where students feel a sense of closeness and connection to others and are motivated to help them; at Level 4 ("Normative Community") the school is valued for its own sake, and can obligate its members to uphold group norms and responsibilities.

Whereas the first construct described levels in students' valuation of the school as an institution, the second construct charted stages in students' valuing of the community. At the lowest level there is no clear sense of community other than as a collection of individuals who do things for each other for concrete, instrumental reasons; then the sense of community emerges on the basis of shared friendships and relationships; and finally the community is considered as an entity apart from specific relationships. At this third stage the community is something one enters on terms of a social contract to respect the norms and ideals of the group.

The third construct describes the evolution of collective norms within the community. At first there is no collective norm, but then, over successive phases, a collective norm is proposed, accepted as an ideal, held out as an expectation for behavior, and then deemed regulative of conduct. In the final phases the collective norm is enforced through persuasion and then by reporting. Power, Higgins, and Kohlberg (1989) argued that a school's moral community is revealed by the development of its collective norms. How willing are members to uphold collective norms, to defend them, to confront violators, to take responsibility for enacting the norm within the life of the school? When hammered out in school meetings a moral community gradually comes to understand collective norms to be "ours" rather than as rules imposed by authority from without ("theirs"), and community members are more committed to abide by them as a result.

Power et al., (1989) showed that students in schools run on the just community model were more advanced than students in comparison schools on the three moral culture variables. Moreover, there was significant (but modest) growth in moral reasoning and improvements in moral behavior. There may be improvements as well in the civic competence of students insofar as it hones the skills required for effective participation in democratic processes and civic affairs (Power & Higgins-D'Alessandro, 2008). Other studies showed that perceived moral atmosphere was linked to lower incidents of adolescent misbehavior and higher incidence of prosocial behavior (Brugman et al., 2003); and that schools that practice just community can be distinguished from comparison schools on several dimensions of moral culture (Host, Brugman, Tavecchio, & Breem, 1998).

This promising evidence aside just-community education has never quite taken off and, as a movement, "is now almost extinct" (Davis, 2003, p. 35). Power and Higgins-D'Alessandro (2008) note at least three reasons for this. First, transforming schools into just communities requires radical reform of the structure and practices of schools and these are not easy to do. Second, many educators resist turning over the school to student democratic decision making. Third, effective implementation requires substantial investment in teacher professional development to ensure buy-in and fidelity to the aims and goals of the model. Moreover, many educators are reluctant to give up much of the instructional day to meetings given widespread anxiety about producing adequate yearly progress on high stakes academic achievement tests. Moral culture, it seems, has given way to testing culture.

Although just community programs as a whole-school reform have not gotten traction, key features of the model, such as class meetings, giving students "voice-and-choice," encouraging moral discussion, improving students sense of connection to teachers and schools, encouraging a sense of community, are now *de rigueur* in most accounts of effective schools (Blum, 2005; National Research Council and Institute of Medicine, 2004) and effective character education (Davidson, Lickona, & Khmelkov, 2008; Lickona, Schaps, & Lewis, 2004). Payne, Gottfredson, and Gottfredson (2003) showed, for example, that schools characterized by communal organization—mutually supportive relationships among teachers, administrators and students, a sense of collaboration, and commitment to common goals and norms—tended to have students who reported attachment to school, a sense of belonging, and belief in the legitimacy of rules and norms.

Indeed, youth who feel connected to school are less likely to be delinquent, use substances, initiate early sexual activity, or engage in violent behavior. They are more likely to report higher levels of academic motivation and lower levels of physical and emotional distress (Battistich, 2008; Elias, Parker, Kash, Weissberg, & O'Brien, 2008; Hawkins et al. 1999). And the benefits of school connectedness have longer term effects. Data from the

National Longitudinal Study of Adolescent Health showed that the sense of belonging to school predicted less depressive symptoms, social rejection, and school problems; and greater optimism and higher grades *one year later* (Anderman, 2002). Similar findings were reported by Loukas, Ripperger-Suhler, and Horton (2009). In their study, middle school adolescents who reported low levels of school connectedness showed increases in conduct problems one year later. Low connectedness in late middle school was also associated with greater anxiety, depressive symptoms, and marijuana use in high school and one-year post–high school (Bond et al., 2007). School connectedness can also buffer the negative effects of poor parenting (Loukas, Roalson, & Herrera, 2010).

These studies point to several conclusions. First, the core features of just community approaches to MCE have been taken up by literatures that underscore the importance of students' perception of community, communal organization, and connectedness. Second, although these literatures do not often invoke the mantle of MCE, they do address psychological (e.g., mental health) and behavioral (e.g., risk and prosocial behavior) outcomes that are of interest to many character educators. Finally, these findings support an emerging consensus, one driven partly by developmental contextualism and by social cognitive theories of personality, that moral failure is not simply the result of disordered private virtue (Lapsley & Narvaez, 2006). Dispositions and settings interact in complex ways, and a stable behavioral signature is to be found at the intersection of person by context interactions (Cervone & Shoda, 1999). This suggests that MCE must attend to the social and communal contexts of teaching and learning as much as to the personal dispositions of students.

Social Domain Theory

Kohlberg's moral stage theory once drove the agenda in cognitive developmental accounts of socialization but no longer. The moral stage theory traded importantly on Piaget's paradigm to articulate its core constructs, such as structure, stage, and sequence; but as Piaget's theory became increasingly eclipsed by alternative accounts of intellectual development, it was not for long that Kohlberg's theory followed it to the margins of developmental science (Lapsley, 2006). But loss of paradigmatic support is not the only explanation. Kohlberg's theory was also troubled by longitudinal data that presented it with prima facie empirical refutation.

Kramer (1968) reported, for example, that adolescents who were once classified at the principled levels (Stage 5 and Stage 6) in high school were found to embrace a kind of relativism more characteristic of Stage 2 on entering college. This is a problem because Kohlberg's stage model forbids regression to earlier (and presumably rejected) stage reasoning (Kohlberg, 1969). Indeed, as noted earlier, Kohlberg (1987) argued that the validity of the moral stage model rested almost entirely on claims for invariant sequence (and on the structured wholeness assumption, which also faced empirical challenges). Hence these data presented Kohlberg with a prima facie refutation of his moral stage theory.

However, on further examination of the protocols (and with new scoring procedures) Kohlberg concluded that the relativism of the university students was quite different from the concrete-individualistic thinking of Stage 2 subjects. The university subjects seemed to be wrestling with relativism as part of an overall moral theory. Although these subjects were once considered principled reasoners in high school, their reasoning could not now be considered principled (because it embraced relativism), though it seemed more sophisticated than conventional reasoning (because it was theoretical). Hence Kohlberg deemed their reasoning to be at a transitional Stage 4½ (Kohlberg, 1973, 1984; Kohlberg & Kramer, 1969). But the appearance of a transition stage forced other revisions. For example, if transitional stage subjects were wrestling with relativistic moral notions but in a theoretical way, should not we also expect principled subjects to be even more theoretical in their moral reflection?

That's indeed how the Kohlberg team saw it. Hence, the principled stages (5 and 6) were now redefined in a philosophic-theoretical way (but with the consequence that Stage 6 receded from empirical view—hardly anyone, other than professional ethicists, reason like that), and the theoretical discourse of transitional Stage 4½ subjects was downsized into a species of conventional reasoning. To make room for theoretical, universalizing language at the conventional level required the creation of A and B substages. The traditional description of conventional reasoning was relegated to the A substage, while the more theoretical kind was now denoted as substage B. The B substage reflects a better appreciation of the prescriptive and universalizable nature of moral judgments, and is oriented toward fairness, equality, and reciprocity. In turn, the A substage was linked with the heteronomous orientation to rules, authority, conventions. This means that the B substage is more "equilibrated" that the A substage, and that moral development can now be said to occur within stage (e.g., moving from Stage 3A to 3B) as well as between stages. Curiously, principled reasoning became at once increasingly rare (with the elimination of Stage 6) but more common (seeping down into the B substages of conventional reasoning).

But some scholars thought that the addition of A and B substages signaled something wrong with the analysis of morality and convention. This was the view of Elliot Turiel (1975, 1977) who began a line of research that identified moral and conventional reasoning as distinct conceptual domains. On his account, what the Kohlberg team was picking up with A and B substages was not the fact that conventional reason ("A") was sometimes prescriptive and universalizing ("B"), but rather that children were trying to coordinate two different conceptual domains. The moral domain and the conventional domain are very different and, as later research would show, even young children know it (Smetana, 1983; Turiel, 1983).

The distinctiveness of moral and conventional reasoning is revealed when children are presented with moral and social dilemmas and asked a series of questions: Would a behavior ("hitting") be okay if there was no rule to prohibit it? If an authority says that it is okay to do it? Is it okay if people in another country do it? What domain analysis reveals is that moral rules are judged to be unalterable, generalizable, and universal, and not contingent on the views of authority. No one can change moral rules no matter how powerful; nor can moral rules be changed by taking a vote or waived because one is from another culture or society. Conventional rules, in contrast, are arbitrary and open to change by consensus. While there are sanctions for violations of conventions, these are not judged as serious as violations of moral rules. Moreover, violations of moral rules evoke strong emotion whereas violations of convention do not (e.g., Arsenio & Lover, 1995).

According to domain theory, the emergence of separate domains of reasoning for morality and convention is the result of qualitatively different kinds of experiences. Morality points to actions that bear on intrinsic harm, on the welfare of others and on matters of interpersonal obligation. Conventions focus on rules and norms that make social organizations work, including schools, communities, and families (Turiel, 1983). Hitting, hurting, stealing, affronting another's dignity and personal worth—these are matters for morality. Whether we address teachers by their first names, go up the down staircase, or respect the 10 p.m. curfew are matters for school and family convention.

According to domain theory, Kohlberg got it wrong when he posited a conventional level of moral reasoning that would be supplanted by a later occurring postconventional level. Conventional reasoning and moral reasoning is not something that is differentiated only at advanced stages of development. Conventional reasoning is not a developmental way station on the steady progress toward principled reasoning. It is not an impoverished and immature form of moral reasoning that is developmentally "lower" on the stage sequence—it is, instead, a conceptually distinct domain. Moreover, it is the independence of morality from conventions that vouchsafes claims against ethical relativism, in contrast to Kohlberg's view that ethical relativism is defeated only at the highest level of moral reasoning. Put differently, for domain theory, ethical relativism is defeated because of (moral and conventional) domain *distinctiveness*; for Kohlberg, it is defeated because of (moral) stage *development*.

A distinct personal domain was identified by Larry Nucci (1996, 2008). Private aspects of one's life and behaviors that affect no one but the self are thought not to invoke considerations of interpersonal moral obligation or social regulation but instead fall within a zone of personal discretion. What books to read or music to enjoy, how to dress and groom, what friends to choose, whether to masturbate or not—these are choices and preferences that resist social regulation and the demands of deontic obligation. The personal domain includes decisions about one's own body and about self-expression and all the things that may fall under the heading of the "pursuit of happiness." Nucci (1996) argued that the construction of a personal zone of privacy and discretion establishes the boundary between agency and communion, between self and others, and is critical to the establishment of a sense of rights-as-freedom and of personal autonomy and identity, insofar as self-conception and identity are grounded on the things we prefer and the choices we make.

While Piaget's theory is on the margins most everywhere else it is sometimes forgotten just how Piagetian is domain theory. The boundaries of moral, conventional, and personal domains are partial structures that are constructed on the basis of certain behavioral experiences. This is precisely the way Piaget described the emergence of domains of conservation (for example). For Piaget, cognitive groupings are based on overt actions that have become interiorized, made part of mental cognitive activity—but groupings always retain an element of content specificity just because they are based on different kinds of overt actions (Chapman, 1988). For example, the conservation of physical quantity derives from interiorized actions of manipulating objects—putting objects together, taking them apart, and transforming their shape, and so on. But the mental operations in the conservation of weight are very different because they pertain to overt acts of a different sort, in this case, weighing. Each grouping of operations is adaptive for its particular content, and some actions are easier to group than others (which accounts for *horizontal decalage*). The construction of social domains seems to follow the logic of the construction of conservation domains. Social domains (moral, conventional, personal) arise as interiorized cognitive constructions of behavioral experiences of certain kinds, and in a manner analogous to the construction of conservation domains (quantity, weight, volume).

But social domain boundaries are often unguarded. The boundaries between the moral, conventional, and personal are elastic, porous, and open to framing, disagreement, and negotiation. Although prototype cases (e.g., hitting and addressing teachers by first names) are more easily distinguished, even at very young ages, wide swaths of our social life are not so easily sorted into one domain or the other. Although domain overlap is sometimes thought to count against the usefulness of domain theory (Rest, 1983), it also points out that some situations (e.g., hitting another person) require the application of only one social knowledge system (in this case, morality), while others involve the intersection of fairness and human welfare with considerations of social convention; while still others involve the intrusion of social convention on matters one considers strictly personal (Nucci, 2008). What makes a case hard is the fact that it is saturated with moral, conventional, and personal considerations that must be unpacked and coordinated; and herein lie the educational implications of domain theory.

Nucci (2001, 2008; cf., Keefer, 2006) believes that values education should be sensitive to domain distinctions. After all, each domain is a bounded structure with its own normative source. Too often the teaching of social values is not aligned with students' differentiated understanding of morality and convention, with issues of great complexity being reduced simply to its moral component. But it is domain inappropriate to moralize about conventional (and personal) domain violations and to treat moral considerations as social conventions or as matters of strictly personal discretion. Even issues such as premarital sexuality or drug usage involve a mélange of moral, conventional, and personal considerations that have to be unpacked (Nucci, Guerra, & Lee, 1991).

Take the matter of peer inclusion and exclusion as another example. Wrapping this complicated issue solely in the discourse of morality will be ineffective because it taps into multiple social reasoning domains (Horn, Daddis, & Killen, 2008). It taps into student *conventions* about group membership and functioning ("The group won't work well with someone different in it"), *personal* concerns about friendship selection ("I can be friends with whoever I want") and *moral* concerns about fairness, harm, and discrimination ("It's not fair to exclude him just because he is gay").

Most children and adolescents oppose peer exclusion as wrong and for moral reasons of unfairness or discrimination, but there are many complications. For example, younger adolescents are more likely to endorse exclusion than are older adolescents, and they typically invoke peer group norms (conventional domain) or personal prerogative (personal domain) in doing so (Horn, 2003; Horn, Killen, & Stangor, 1999). Exclusion is deemed more legitimate in intimate contexts involving friendship and dating than less intimate contexts, such as school clubs and extracurricular activities (Killen, Lee-Kim, McGlothlin, & Stangor, 2002; Killen, Stangor, Price, Horn, & Sechrist, 2004). When relevant information about a peer is missing, many adolescents resort to stereotypes and in-group bias to make judgments about the acceptability of inclusion or exclusion—individuals who better fit normative expectations about what a good group member is like are more likely to be included (Killen & Stangor, 2001). Pick the girl for the ballet troupe over the boy; exclude the girl from the wrestling team. Exclusion is more likely if a person violates normative assumptions regarding gender, sexuality, and race (Horn, 2007; Killen et al., 2002). The status of one's peer group also influences judgments of inclusion-exclusion. Members of high status peer groups (e.g., jocks) think better of exclusion and of the legitimacy of the social system that rewards them with status and prestige than do members of low-status groups (e.g., goths), who more likely condemn the legitimacy of the social hierarchy on moral grounds (Horn, 2006).

The issues surrounding inclusion and exclusion in children and adolescents illustrate the complexities of domain overlap in useful ways. It also illustrates how context (e.g., school setting) and developmental status interpenetrates issues of morality and convention. Horn et al. (2008) argue that the construction of normative expectations about group membership helps adolescents assert and defend nascent understanding of self and identity, which is a salient developmental task of adolescence. Who am I, where do I fit, what am I like, and similar identity questions are not asked in a vacuum but in a social context riven with concerns about peer group membership, status, and friendship. Similarly, it is in the context of peer groups that a growing need for autonomy is expressed, and in terms of personal prerogative (e.g., who to be friends *with*). As Horn et al. (2008) put it:

> In early and middle adolescence individuals are coming to a more complex understanding of the nature and function of social groups, group conventions and norms, as well as their own emerging identities and their sense of personal prerogative and autonomy and as a result they begin to use the peer group context as a place to test out and to make sense of these new understandings. (p. 279)

For these good developmental reasons do young adolescents give priority to group functioning and group norms, and personal prerogative, over moral considerations of harm, discrimination, and fairness when it comes to peer inclusion-exclusion.

Finally, domain theory has implications for disciplinary practices. Research shows that teachers who make domain-inappropriate responses to student transgression undermine their credibility as socialization agents among both preschool (Killen, Breton, Ferguson, & Handler, 1994) and grade-school-age children (Nucci, 2008). Insofar as most classroom misbehavior involves violations of convention, it would be a mistake to moralize about these transgressions. For one thing, it diminishes the force of moral argument when it is sent chasing after matters of convention; but it also misses opportunities to engage student thinking about legitimate issues of classroom or school convention (Nucci).

Moral Self-Identity

Moral-character education presumably intends to influence the personality of children; or to leave its mark in a way that canalizes a disposition to morality; or else cultivate those ethical virtues that conduce to living well the life that is good for one to live. Character can be considered the moral dimension of personality, and many writers have drawn a tight connection between morality and self-identity (Flanagan & Rorty, 1990). As Taylor (1989) put it, "Being a self is inseparable from existing in a space of moral issues" (p. 112). As a result there has been much interest in exploring the literatures of self-identity and personality for insights about moral functioning and for MCE (Blasi, 1993, 2005; Frimer & Walker, 2009; Lapsley, 2008; Lapsley & Hill, 2009; Lapsley & Narvaez, 2004; Walker & Frimer, 2009).

The moral self was not entirely absent in the theoretical views presented earlier. For example, Power (2004) argues that a moral self emerges in the context of a just community. One's sense of identification with the group and its communal norms will generate a moral atmosphere that either conduces to moral formation or undermines it. Hence moral self-identity is a matter of group identification and shared commitment to its value-laden norms. The moral self identifies with the community by speaking on behalf of its shared norms and by taking on its obligations as binding on the self.

But this might happen in phases. In an early phase (following Blasi, 1988), one simply acknowledges that one is a member of a group and is bound thereby to group norms (*Identity Observed*). Then, one speaks up more actively in defense of a group norm, and in urging the community to abide by its commitments (*Identity Managed*). Finally, one takes "legislative responsibility for constructing group norms" (Power, 2004, p. 55; *Identity Constructed*). Power (2004) argues that the democratic process challenges members to "appropriate" community group membership into one's personal identity.

Social domain theory also invokes the language of self-identity. Although Nucci (2004) is skeptical of moral self-identity or moral personality as constructs, he argues that the establishment of selfhood, individuality, and agency is advanced as young children begin to carve out personal prerogatives and a zone of privacy. Put differently, the development of self emerges apace with the construction of the personal domain. And we have seen how young adolescents test notions of identity and autonomy in the group norms and conventions that govern peer inclusion-exclusion (Horn et al., 2008).

But many researchers are looking for a more robust account of the moral dimensions of selfhood and identity. After all, the personal domain *presumes a person*, and persons are more than the sum of domain coordinations. Although allowance is made for the emergence of self in the construction of the personal domain, it could well be asked how dimensions of personality—moral identity, the moral self, the virtuous character—influences the way domain knowledge is deployed or coordinated; or how the deployment of social domain knowledge folds back into one's changing conceptions of who I am and what my life means. It is likely that what is seen in the social landscape depends importantly on *who we are.* Whether the landscape is moralized or personalized, whether the case is straightforward or ambiguous—depends on the qualities of seeing that are afforded by the person we are or aspire to be, that is, by the qualities of our character.

Blasi (1984, 1993) has written many searching things about the moral personality, and his work is foundational to the moral psychology of self-identity. According to Blasi, a moral personality emerges when the sense of self is constructed on the basis of moral commitments. For these individuals moral notions are central, essential, and important to self-understanding. Moral commitments cut deeply to the core of what and who they are as persons. But not everyone constructs the self by reference to moral categories. For some individuals moral considerations do not penetrate their understanding of who they are as persons; nor influence their outlook on important issues; nor "come to mind" when faced with the innumerable transactions of daily life. Some have only a glancing acquaintance with morality but choose to define the self by reference to other priorities; or else incorporate morality into their personality in different degrees; or emphasize some moral considerations ("justice") but not others ("caring").

Hence moral identity is a dimension of individual differences, which is to say, it is a way of talking about personality. One has a moral identity to the extent that moral notions, such as being good, being just, compassionate, or fair, is judged to be central, essential, and important to one's self-understanding. One has a moral identity when one strives to keep faith with identity-defining moral commitments; and when moral claims stake out the very terms of reference for the sort of person one claims to be. Moreover, if moral considerations are crucial to the essential self, then self-integrity will hinge on whether one is self-consistent in action. And failing to act in a way that is self-consistent with what is central, essential and important to one's moral identity is to risk self-betrayal (Hardy & Carlo, 2005).

In his analysis of moral character, Blasi (2005) distinguishes higher and lower-order virtues. Lower-order virtues are the many specific traits that show up in many character educators' favored list of core values: empathy, honesty, compassion, kindness, diligence, and so on. Higher-order traits come in two clusters. One cluster Blasi called "willpower" (or self-control). Willpower as self-control is a toolbox of skills that permit self-regulation in problem-solving. Breaking down problems, goal-setting, focusing attention, avoiding distractions, resisting temptation, staying on task, persevering with determination and self-discipline—these are the skills of willpower. Davidson et al. (2008) would call it performance character.

The second cluster of higher-order traits are organized around the notion of integrity, which refers to internal self-consistency. Being a person of one's word, being transparent to oneself, being responsible, self-accountable, sincere, resistant to self-deception—these are the dispositions of integrity. Integrity is felt as *responsibility* when we constrain the self with intentional acts of self- control in the pursuit of our moral aims. Integrity is felt as *identity* when we imbue the construction of self-meaning with moral desires. When constructed in this way, living out one's moral commitments does not feel like a choice but is felt instead as a matter of self-necessity. This suggests that self-control and integrity are morally neutral but take on significance for moral character only when they are attached to moral desires. Our self-control and integrity are *moralized* by our desire to keep faith with morality.

Blasi's rich theoretical claims have yet to be translated into sustained empirical research, yet there are lines of research that do encourage the general thrust of his work. For example, moral identity is used to explain the motivation of individuals who sheltered Jews during the Nazi Holocaust (Monroe, 1994, 2001, 2003). The study of "moral exemplars"—adults whose lives are marked by extraordinary moral commitment—reveal a sense of self that is aligned with moral goals, and moral action undertaken as a matter of felt necessity rather than as a product of effortful deliberation (Colby & Damon, 1992). Similar findings are reported in studies of youth. In one study adolescents who were nominated by community organizations for their uncommon prosocial commitment ("care exemplars") were more likely to include moral goals and moral traits in their self-descriptions than were matched comparison adolescents (Hart & Fegley, 1995; Reimer, 2003).

Moral exemplars also show more progress in adult identity development (Matsuba & Walker, 2004), and report self-conceptions that are replete with agentic themes, ideological depth, and complexity (Matsuba & Walker, 2005). In a study of exemplars who won the Canadian Caring Award or the Medal of Bravery, Walker and Frimer (2009) showed that there was a foundational core to moral exemplarity that distinguished them from matched controls. For example, in an analysis of integrative life review narratives (following McAdams, 1993), exemplars reported more evidence of agentic and communal themes than did controls, a greater tendency to reframe critical life events in terms of redemption (e.g., when a demonstrably negative state leads to a positive one; or when the initial negative state is redeemed or salvaged in some way); and to see early life advantages in terms of secure attachments and the presence of helpers.

Daniel Hart (2005) articulated a developmental systems model of moral identity that is distinctive for its account of the factors that influence moral identity formation. Five factors are arrayed into two groups (that differ on the basis of volitional control). The first group includes (1) enduring dispositional and (2) social (including family, culture, social class) characteristics that change slowly and are probably beyond the volitional control of the developing child. As Hart (2005, p. 179) put it, "Enduring personality characteristics, one's family, one's culture and location in a social structure, all shape moral life." But these things are beyond the control of the child. Children do not select their personality traits; they do not select their home environments or neighborhood, though these settings will influence the contour of their moral formation. As a result, there is a certain *moral luck* (Nagel, 1979; Williams, 1971) involved in the way one's moral life goes depending on the favorability of one's ecological circumstances—including the *goodness of fit* between one's enduring personality dispositions and the contextual settings of development.

The second group includes (3) moral judgment and attitudes, (4) the sense of self (including commitment to ideals) and (5) opportunities for moral action. These factors are closer to the volitional control of the agent and introduce more malleability and plasticity in moral identity formation. Not surprisingly they also hold the most promise for MCE. Indeed, the moral exemplar (e.g., Colby & Damon, 1992) and systems (Hart, 2005) approach to moral self-identity lead to similar educational recommendations.

For example, moral exemplar research holds out as a goal the sort of prosocial commitment exhibited by care exemplars. But how do individuals come to align personal goals with moral ones; or come to identify the self with ideal goals? Colby and Damon (1992) nominate social influence as a decisive mechanism. The key, in their view, is for young people to become absorbed by social networks that have moral goals. Social influence plays a decisive role in transforming personal goals into important moral commitments. It provides a context for reappraisal of one's current capabilities, guidance on how best to extend one's capabilities, and the strategies required to pull it off. "For those who continually immerse themselves in moral concerns and in social networks absorbed by such concerns, goal transformation remains the central architect of progressive change throughout life" (Colby & Damon, 1995, p. 344).

Similarly, Hart's (2005) research illustrates the importance of cultivating attachment to organizations that provide social opportunities for young people to engage their communities in prosocial service. There is a significant literature that documents the salutary effect of participation in voluntary organizations and service learning opportunities more generally on prosocial behavior and moral civic identity (C. Flanagan, 2004; Youniss & Yates, 1997, 1999). Connecting young people with prosocial institutions and giving them opportunities for moral engagement with their community may be crucial components of effective MCE. The challenge for MCE is figure out how to transform the culture of schools into places where social networks are absorbed by moral concerns, where attachment to school is encouraged and where opportunities abound for broad participation in voluntary associations that permit prosocial engagement in the school and community (Lapsley & Narvaez, 2006).

Thus far we have treated MCE as something that takes place in schools. In fact MCE is also the province of families and of early life experience and it is here where the foundation of moral personality, character, and selfhood are first laid down. We examine the early roots of moral formation later in the chapter, but two additional developmental theories inform the question of moral identity. The first concerns the development of conscience (Kochanska, 2002; Kochanska & Aksan, 2004). The second concerns the early development of moral personality (Narvaez & Lapsley, 2005, 2009). We take up only the matter of conscience here because of its more direct implication for MCE.

Conscience. One important feature of Blasi's theory is his insistence that one's character is defined mostly by what one cares about. A moral character cares about morality. A moral character has the self-reflective capacity to reflect upon one's desires and motives, to form judgments and desires with respect to them. Indeed, the character virtues of self-control and integrity take on significance, that is, become moralized, only when attached to moral desires. What is the developmental source of such desiring?

We think Kochanska's (2002) work on the development of conscience is a good place to start. Her model of emerging morality begins with the quality of parent-child attachment. A strong, mutually responsive relationship with caregivers orients the child to be receptive to parental influence (Kochanska, 1997). This "mutually responsive orientation" (MRO) is characterized by shared positive affect, mutually coordinated enjoyable routines ("good times"), and a "cooperative interpersonal set" that describes the joint willingness of parent and child to initiate and reciprocate relational overtures. It is from within the context of the MRO, and the secure attachment that it denotes, that the child is eager to comply with parental expectations and standards. It encourages wholehearted, willing, and committed compliance on the part of the child to the norms and values of caregivers, which, in turn, motivates moral internalization and the work of "conscience." This was documented in a recent longitudinal study. Children who had experienced a highly responsive relationship with mothers over the first 24 months of life strongly embraced maternal prohibitions and gave evidence of strong self-regulation skills at preschool age (Kochanska, Aksan, Prisco, & Adams, 2008).

Kochanska's model moves, then, from security of attachment (MRO) to committed compliance to moral internalization. This movement is also expected to influence the child's emerging internal representation of the self. As Kochanska (2002) put it:

> Children with a strong history of committed compliance with the parent are likely gradually to come to view themselves as embracing the parent's values and rules. Such a moral self, in turn, comes to serve as the regulator of future moral conduct and, more generally, of early morality. (p. 340)

Lapsley and Narvaez (2006) argued that the source of wholehearted commitment to morality required by Blasi's moral desiring may lie in the mutually responsive orientation that characterizes secure interpersonal attachments. The moral self emerges in the context of these relationships; and the developmental source of integrity, self-control, and moral desires is deeply relational. If the Kochanska model of early morality can be generalized it would underscore the importance of school bonding (Catalano, Haggerty, Oesterle, Fleming, & Hawkins, 2004), of caring school communities (Solomon, Watson, Battistich, Schaps, & Delucchi, 1996) and attachment to teachers (Watson, 2003) as a basis for prosocial moral development, and as important features of MCE.

PROGRAMMATIC APPROACHES

In this section we briefly review several programmatic approaches that seem to yield empirically supported outcomes that are relevant to MCE. First we begin with an overview of the principles of effective character education advocated by the Character Education Partnership, and then we examine programs endorsed by the "what works" evaluation literature.

CEP Principles

The Character Education Partnership (CEP) is a coalition of organizations and individuals dedicated to helping schools develop moral and character education programs. The CEP developed eleven principles of effective character education (Beland, 2003). The first principle (Principle 1) asserts that good character is built on the foundation of core ethical values, such as caring, honesty, fairness, responsibility, and respect. What is critical is that the values selected for character education be universally valid, promote the common good, affirm human dignity, contribute to the welfare of the individual, deal with issues of right and wrong, and facilitate democratic practices.

Accordingly, programs should teach core values holistically with cognitive, affective, and behavioral components (Principle 2), and in a way that engages school personnel in an intentional, proactive, and comprehensive way (Principle 3). It is particularly important to create caring school communities (Principle 4) and to provide students with opportunities to engage in moral action, such as service learning and community service (Principle 5). Effective character education does not neglect rigorous, challenging academic curriculum (Principle 6). It fosters intrinsic motivation to do the right thing by building a climate of trust and respect; by encouraging a sense of autonomy; and by building shared norms through dialogue, class meetings, and democratic decision-making (Principle 7). Moreover, the core values that animate student life should engage the school staff, as well (Principle 8). Furthermore, for character education to take root it must result in shared educational leadership that makes provision for long-term support of the initiative (Principle 9); it must engage families and community stakeholders (Principle 10); and be committed to on-going assessment and evaluation (Principle 11).

This remarkable set of principles provides a useful guidepost for the design and implementation of intentional, programmatic, and comprehensive character education. It insists that ethical considerations be the transparent rationale for programmatic activities and, on this basis (e.g., Principle 3), would not support efforts to broaden the definition of character education to include all manner of prevention and intervention programs absent an explicit, intentional concern for moral development. It endorses a set of well-attested pedagogical strategies that are considered educational best practice, including cooperative learning, democratic classrooms, and constructivist approaches to teaching and learning. It endorses practices that cultivate autonomy, intrinsic motivation, and community engagement. Indeed, the CEP Principles look more like the blueprint for progressive education, and would seem to settle the historical debate concerning direct and indirect approaches to character education in favor of the latter paradigm.

What Works?

What Works Clearinghouse

The Institute for Educational Sciences (IES) of the U.S. Department of Education maintains a What Works Clearinghouse (WWC) that catalogs the empirical evidence on the efficacy of educational interventions and curricula, including character education. For the WWC, character refers to moral and ethical qualities as these are demonstrated in emotions, reasoning, and behavior. It is associated with core virtues such as respect, responsibility, fairness, caring, and citizenship; and CE refers to school-based programs that are designed to positively influence behavior associated with these qualities. Moreover, CE is defined in a way that excludes single-minded focus on single risk behaviors (e.g., drug usage) or competency (conflict resolution) in favor of instructional activities that focus on values that generalize across contexts. Examples include values that attach to *persons* (honesty, courage, perseverance, self-discipline, responsibility, integrity); to *relationships* (caring, respect, empathy, fairness, tolerance); and to *civic virtues* (good citizenship, patriotism, justice).

These core values are assumed to have cognitive, emotional, and behavioral components, and these should show improvement as a result of CE. Hence, students should come to know what values mean, how to reason about them, and how to sort through the value implications of ethical dilemmas. There is also an emotional dimension. Students should care about values and have certain attitudes and feelings with respect to them. Values should influence behavior. Students must display behavior that reflects a commitment to core values, either as prosocial behavior for the benefit of peers or the community, or as a reduction in risk behavior. In short, CE must result in character development whereby students come to understand values, care about them, and enact them in behavior. To this end the WWC groups student outcomes in its evaluation of CE into the three domains of (1) knowledge, attitudes, and values and (2) behavior; and adds a third domain of (3) academic achievement.

To be included in the WWC a character education intervention must be a *program*, a *practice* or *strategy*, or a *policy*, and it must be one that passes an exacting evidence protocol. For example, evaluation studies must use randomized trials or quasi-experimental designs with strong controls, and to have been conducted within the last 20 years using K-12 students between the ages of 5 and 21. Outcome measures must have adequate levels of internal consistency (.60), temporal stability/test-retest (.40), and interrating reliability (.50). Evidence on subgroups (e.g., age, grade, gender, disability status, ethno-racial classification, at-risk and SES status) must be available. There must not be differential attrition from the intervention and control groups (<7% is deemed unproblematic), and the overall attrition from the study sample must not be severe (<20% is deemed minimal).

These screening criteria exclude many programs from consideration (and WWC does not evaluate the even larger domain of character education products, such as curricular workbooks, videos and CD-ROMs). For interventions that pass muster, the WWC rates program effectiveness as: positive, potentially positive, mixed, no discernible effects, potentially negative, or negative. These ratings are based on four factors: (1) the quality of the research design, (2) the statistical significance of the findings *as calculated by the WWC*, (3) the size of the difference between participants in the intervention condition and the comparison conditions, and (4) the consistency of the findings across studies.

Table 7.3 is a summary of program effectiveness across outcome variables for the 13 programs (out of 41) that

TABLE 7.3 What Works Clearinghouse: Character Education

Intervention	Improvement Outcomes		
	Knowledge, Attitudes, Values	Behavior	Academic Achievement
Building decision skills (with service learning)	Potentially positive	No report	No report
Child development project	No discernible effect	Potentially positive	No discernible effect
Connect with kids	No report	Potentially positive	No report
Too good for drugs	No discernible effect		
Too good for violence	Potentially positive	Potentially positive	No report
Too good for drugs & violence	Positive effects	No report	No report
Heartland ethics curriculum	No discernible effect	No discernible effect	No report
Facing history and ourselves	No discernible effect	No discernible effect	No report
Lessons in character	No discernible effect	No discernible effect	No report
Positive action	Positive effect	Not applicable	Positive effects
Lions quest: Skills for action	No report	No discernible effects	No report
Lions quest: Skills for adolescents	Potentially positive	No report	No report
Voices literature and character education	No discernible effects	Not reported	Not reported

Source: Institute for Educational Sciences, U.S. Department of Education.

meet the screening protocol. The first thing to notice is that after decades of visibility as an educational priority only 13 programs make the evidentiary cut to be included in the WWC.

The second thing to notice is how thin the evidence is for CE. Only 5 of 13 programs are at least potentially efficacious in influencing knowledge, attitudes and values; only 3 influence behavior and just one program influences academic achievement. The program Positive Action had the clearest positive results and in two domains of outcomes. The Positive Action curriculum consists of 6 units (140 lessons for elementary school, 81 lessons for seventh grade, 75 lessons for eighth grade, and 132 lessons for high school) taught over consecutive days in scripted lessons by trained teachers (typical lessons last about 15 minutes). The lessons are infused by the philosophy “You feel good about yourself when you think and do positive actions, and there is a positive way to do everything,” and involve classroom discussion, role-play, games, songs, and activity sheets.

The Too Good for Violence (TGV) and Too Good for Drugs and Violence (TGDV) programs are also highly promising. These programs are included in WWC because they infuse character traits into most of the lessons. TFV consists of seven 30- to 60-minute lessons per elementary grade level and nine 30- to 45-minute lessons for middle school. All lessons are scripted and teachers are trained to deliver them. Lessons concern peaceful conflict resolution and prosocial skill development in the areas of goal-setting, decision making, anger and stress management, among others. Eight character values are addressed: caring, cooperation, courage, fairness, honesty, respect, responsibility, and self-discipline. TGDV consists of 14 core curriculum lessons at 60 minutes each that are intended to be infused in subject area content. What is interesting about TFDV is that many lessons include information about normative peer drug use, which other research has shown to be the most effective component of drug prevention programs (Andrews, Hampson, & Peterson, 2011; McAlaney, Bewick, & Hughes, 2011). Many teens overestimate the degree to which peers are engaged in substance use (and other risk behaviors), and correcting faulty perceptions of peer normative behavior is a highly recommended instructional goal. TGDV also engages in skill-development (e.g., goal-setting, decision making, stress management, peer resistance) and utilizes cooperative learning activities and role-playing to develop positive behaviors.

The one surprise concerns the Child Development Project (CDP). The CDP is a storied intervention that has a strongly supportive empirical basis in the literature (Battistich, 2008). The programmatic focus of the CDP was designed to enhance prosocial development by creating the condition for a caring school community (Battistich, Solomon, Watson, & Schaps, 1997). A sense of community was encouraged through activities such as collaborating on common academic goals; providing and receiving help from others; discussion and reflection upon the experiences of self and others as it relates to prosocial values such as fairness, social responsibility, and justice; practicing social competencies; and exercising autonomy by participating in decisions about classroom life and taking responsibility for it (Solomon et al., 1996). For example, teachers who hold class meetings, use cooperative learning strategies, and discuss prosocial values are more likely to foster a sense of community in students. Schools that provide cross-age buddies, homework that links school and family, and school-wide projects also promote a sense of community. Moreover the CDP encouraged an approach to classroom management that emphasized induction and developmental discipline (Watson, 2003).

Research on CDP implementations showed that program students (vs. controls) exhibited more prosocial behavior in the classroom (Solomon, Watson, Delucchi, Schaps, & Battistich, 1988), more democratic values and interpersonal understanding (Solomon, Watson, Schaps, Battistich, & Solomon, 1990), and social problem-solving and conflict resolution skills (Battistich, Solomon, Watson, Solomon, & Schaps, 1989). Students in CDP schools were more likely to view their classrooms as communities, and this sense of community was positively related to self-reported concern for others, conflict resolution skills, altruistic behavior, intrinsic prosocial motivation, trust in and respect for teachers, enjoyment of helping others learn as well as observations of positive interpersonal behavior and academic engagement (Battistich, Solomon, Watson, & Schaps, 1996). When program and control students entered the same intermediate school, former program students were rated higher by teachers at eighth grade in conflict resolution skills, self-esteem, assertion, and popularity (Solomon, Watson, & Battistich, 2002).

But this highly encouraging evidence is not reflected in the WWC scorecard, which reports no discernible evidence for Knowledge, Attitudes, and Values or for Academic Achievement and only potential effectiveness for Behavior. This lower estimation of CDP effectiveness is the result of WWC recalculating statistical significance of the various outcomes using corrections for clustering within classrooms or schools and for multiple comparisons. Moreover, the average effect sizes across all findings in each of the domains were deemed not large enough to be considered substantively important according to the WWC standards (i.e., at least 0.25).

What Works for Character Education (WWCE)

Marvin Berkowitz and his colleagues have also examined the literature in search for what works in character education (Berkowitz et al., 2008; Berkowitz & Bier, 2004). Their search identified more programs than did the WWC, including 69 program outcome studies (representing 33 CE programs) along with more extensive reviews of the literatures on the effects of moral discussion (over 100 studies on this topic alone) and on a specific CE program (Teaching Students to Be Peacemakers) that is based on cooperative learning. Berkowitz et al. (2008) note two reasons for the difference in the pool of studies reviewed by the two projects. First, the WWC used a more restrictive definition of what counts as a character education program, focusing their attention only on programs that targeted an explicit character trait or moral and ethical reasoning development. Hence WWC adopted a narrow, nonexpansive view of MCE (in terms used earlier) or, alternatively, the WWC only considered programs were CE was considered a *treatment*. In contrast, WWCE used a less restrictive (and hence broad, expansive) definition and included studies that focused on *outcomes* of interest to CE as instances of CE. Second, as noted earlier, the WWC used rigorous methodological inclusion criteria to screen studies *eligible* for review. WWCE was also interested in studies that used comparative designs but otherwise was less restrictive with respect to methodological inclusion criteria.

There was overlap in the programs reviewed by the two "what works" projects. Seven programs were in common of the 33 programs reviewed by WWCE and the 13 reviewed by WWC. Of these seven there was disagreement about two of them (Facing History and Ourselves and Lions Quest Skills for Action was deemed ineffective by WWC but effective by WWCE). But there was agreement that four programs held in common showed at least some evidence of effectiveness (Building Decision Skills, Child Development Project, Lions Quest Skills for Adolescents, and Positive Action) and that one did not (Heartwood Ethics Curriculum). Program effectiveness was also reported for five programs in WWC that was not included by WWCE (Connect with Kids, Lessons in Character, and the three Too Good for Kids programs).

The programs deemed effective and uniquely reviewed by WWCE were an eclectic and varied lot. It included just community schools and moral dilemma discussion strategies. It included programs that focused on social competency and social decision-making, life-skills training, problem solving, and peacemaking. Positive youth development was included as effective CE. One program, Roots of Empathy, is a program for school-age children that provides opportunities for structured interactions with a baby over the course of the child's early development (Gordon, 2005). Students observe the baby's development and learn to name feelings and on this basis become fluent in emotional literacy, which allows students to resist bullying, taunting, and cruelty; and to lay the foundation for caring, safe classrooms and schools. Research shows that Roots of Empathy is associated with increases in social and emotional knowledge, prosocial behavior (sharing and helping), and perceptions of caring classrooms; and decreases in aggressive behavior (Schonert-Reichl & Scott, 2005).

WWCE also includes the Seattle Social Development Project (SSDP). The project was launched in 1981 in eight Seattle public elementary schools. By 1985, it expanded to include all fifth-grade students in 18 elementary schools, with additional intervention components that targeted parents and teachers as well. The longitudinal assessments of participants continued throughout adolescence and subsequently every three years after graduation until age 27.

The SSDP was guided by a social development model that assumed that one becomes socialized within the norms of a social group to the extent that (1) one perceives opportunities for involvement, (2) becomes actually involved, (3) has the skill for involvement and interaction, and (4) perceives that it is rewarding to do so. When socialization goes well a social bond of attachment and commitment is formed. This social bond, in turn, orients the child to the norms and expectations of the group to which one is attached and to the values endorsed by the group. "It is hypothesized that the behavior of the individual would be prosocial or antisocial depending on the predominant behaviors, norms and values held by those individuals and institutions to which/whom the individual bonded" (Catalano, Haggerty et al., 2004, p. 251).

The SSDP included interventions that targeted three primary socialization agents of school-age children: teachers, parents, and peers. Teachers were given training in proactive classroom management, interactive teaching to motivate learners, and cooperative learning. The intervention for children targeted social and emotional skill development, including interpersonal cognitive problem-solving skills and refusal skills. Parental training targeted behavior management, how to give academic support and skills to reduce risks for drug use.

Research showed that training teachers to use targeted teaching practices was successful in promoting both school bonding and academic achievement (Abbott et al., 1998). Moreover, the SSDP demonstrated long-term positive effects on numerous adolescent health-risk behaviors (e.g., violent delinquency, heavy drinking, sexual intercourse, having multiple sex partners, pregnancy, and school misconduct) and on school bonding (Hawkins et al., 1999; Hawkins, Guo, Hill, Battin-Pearson, & Abbott, 2001). For example, school bonding at 12th grade, and increases in school bonding between 7th and 12th grade, was negatively correlated with use of alcohol, cigarettes, marijuana, and other drug use at 12th grade. Students bonded to school at 5th and 6th grade were less likely to become minor or major offenders in middle school. Students with a lower sense of school attachment and commitment were twice as likely to join gangs as were students with a stronger sense of school bonding. School bonding also had positive academic outcomes. For example, an increase in school bonding between 7th and 12th grade was associated with higher GPA and lower student misconduct at 12th grade. Students with greater bonding to school at 8th grade were less likely to drop out of school by 10th grade (see Catalano, Berglund, Ryan, Lonczak, & Hawkins, 2004, for a review).

Hence, the intensive multicomponent interventions of the SSDP had clear effects on school bonding and on a range of outcomes of traditional interest to character educators, including substance use, delinquency, gang membership, violence, academic problems, and sexual activity. Although the work of the SSDP is guided by the social development model and not by considerations of virtue, morality of character, it reports *outcomes* of interest to character educators, and for this reason is included in the WWCE data base (as opposed to the WWC data base, which only includes programs that are interventions more narrowly linked to morality).

As noted earlier, the distinction between CE as treatment and as outcome is an important one between the WWC and the WWCE data bases. Berkowitz et al. (2008) provide the variable outcome taxonomy that guided their coding of CE programs in the WWCE project. At the most general level outcome variables were coded into one of four categories: Risk Behavior, Prosocial Competencies, School-Based Outcomes, and General Social-Emotional. At the intermediate level it is evident that most of what we think of with respect to moral-character is located under the heading of Prosocial Competencies. Some of the intermediate categories here include Socio-Moral Cognition, Personal Morality, Prosocial Behavior and Attitudes, and Character Knowledge, among others.

The intermediate concepts under the other general headings cast a much wider net over psychosocial functioning. For example, under the general rubric “General Social-Emotional” is grouped intermediate variables such as Self-Concept, Independence and Initiative, Coping, Problem-Solving Skills, Emotional Competency, and Attitudes and Beliefs (about older people, school, the future). Under the general rubric School-Based Outcomes are intermediate variables such as School Behavior (e.g., attendance, detentions, skipping school, compliance with rules), Attachment to School, Attitudes Toward School, Attitudes Toward Teachers, Academic Goal, Expectations and Motives, Academic Achievement and Academic Skills. The general category Risk Behavior has six intermediary categories that includes Knowledge and Beliefs (about risk), Drug Use, Sexual Behavior, Protective Skills (e.g., refusal skills), Violence/Aggression and General Misbehavior (e.g., gang activity, lying, rude behavior, stealing). This gives one a sense of the wide terrain that WWCE attempted to map.

Berkowitz et al. (2008) report how often these variables were statistically significant across the various research studies examined in the database. Table 7.4 is a summary of the top ten intermediate variables that reported significant effects and also the top 10 variables with the highest percentage of significant effects.

TABLE 7.4 Summary of Significant Effects for What Works in Character Education

Ten Most Commonly Reported Significant Effects		Variables with Highest Percentage of Significant Effects	
Variable	N of Significant Effects	Variable	% of Significant Effects
Socio-moral cognition	82/111 tested	Sexual behavior	90 (10/11)
Prosocial behaviors	71/167 tested	Character knowledge	87 (13/15)
Problem-solving skills	54/84 tested	Socio-moral cognition	74 (82/111)
Drug use	51/104 tested	Problem-solving skills	64 (54/84)
Violence/aggression	50/104 tested	Emotional competency	64 (31/49)
School behavior	40/88 tested	Relationships	62 (8/13)
Knowledge/attitudes about risk behavior	35/73 tested	Attachment to school	59 (19/32)
Emotional competency	32/50 tested	Academic achievement	59 (31/52)
Academic achievement	31/52 tested	Communicative competency	50 (6/12)
Attachment to school	19/32 tested	Attitudes toward teachers	50 (2/4)

Source: Berkowitz, Battistich, & Bier (2008).

On the basis of these outcomes, Berkowitz et al. (2008) draw at least three conclusions. First, CE can promote character development. When the WWC and WWCE findings are jointly considered, 39 programs show some evidence of effectiveness. Second, CE positively influences academic achievement. Third, and as Table 7.4 illustrates, CE has a broad impact on a wide variety of psychosocial outcomes.

EFFECTIVE DELIVERY MECHANISMS

Effective strategies for educating moral character are not always straightforward. In this section we compare *traditional* implementation strategies (i.e., those relying on explicit persuasion, teaching of skills, or changes in classroom culture) to new *indirect* or "stealthy" intervention strategies (Miller & Prentice, in press; Robinson, in press; Yeager & Walton, 2011).

Are Traditional Intervention Methods Frequently Effective?

It is important to carefully consider traditional methods of moral character education because even programs that seem intuitively effective can have no effect or, at worst, do harm—even when the participants themselves say it was helpful. For example, Silvia et al. (2010) delivered a two-pronged intervention to reduce youth violence in the context of a randomized experiment including 7,000 middle school students. They delivered (1) a 16-lesson classroom curriculum that targeted effective problem-solving skills, motivation and self-efficacy for those skills, and attitudes about the utility of violence, and (2) a whole-school component that included a review and refinement of school discipline policies, public and positive reinforcement of prosocial behaviors, clarification of behavioral expectations, and systematic review of discipline data. After one year, this intervention had no effect on violence, victimization, safety concerns, prosocial behavior, attitudes toward violence, or strategies for coping with aggression—despite evidence that the intervention was delivered reasonably well by teachers and administrators (Silvia et al., 2010).

That interventions can harm is illustrated by the well-known Cambridge-Somerville Youth Study (McCord, 1978; see also Ross & Nisbett, 1991), an ambitious early effort to promote character among at-risk youth. In 1939, more than 500 boys aged 5 to 13 were randomly assigned to either a comprehensive youth development treatment group or to a control group. In the treatment group, boys and their families met with counselors twice per month; they received tutoring and psychiatric help; they attended summer camp; and they joined the Boy Scouts, the YMCA, or a similar program. In effect, they received every service that, at that time, was thought to transmit moral character. In the control group, none of these services were provided. Yet 30 years later, boys in the treatment group were no less likely to have committed a crime (McCord, 1978). In fact, the intervention seemed to cause harm. Men who were in the treatment group were more likely to have committed more than one crime; more likely to be alcoholic, have a diagnosis for a serious mental illness, and have a stress-related disease; and less likely to be satisfied with their careers. Treated men also died at younger ages (McCord). Shockingly, in a survey 30 years after the treatment, two thirds said that the program benefitted them, even though the evidence suggested it did not.

These are not isolated results. Meta-analyses and narrative reviews have frequently found that well-intentioned youth development intervention strategies can do harm (Dishion, McCord, & Poulin, 1999; Lilienfeld, 2007; Rhule, 2005). This was true in the case of Scared Straight programs—a practice of having youth spend a night in jail, or other harsh experiences, in order to deter criminal behavior. These programs increased the odds of committing a crime by an odds ratio of nearly 1.6 (Petrosino, Turpin-Petrosino, & Buehler, 2003). Similarly, zero tolerance policies, which deliver severe consequences for a single instance of undesirable behavior, not only fails to reduce conduct problems in school but also increases racial inequalities in discipline by justifying racial profiling (Skiba et al., 2006). DARE or other programs designed to help teens resist social influence seem to increase the use of alcohol or other drugs, perhaps by teaching them about new drug-use strategies and facilitating conversations with peers about carrying them out (Werch & Owen, 2002). And anti-bullying interventions conducted in high schools frequently increase the rate of bullying in a school (Cowie & Olafsson, 2000; DeSouza & Ribeiro, 2005; Hanewinkel, 2004; Kaiser-Ulrey, 2003; Metropolitan Area Child Study Research Group, 2002; Pepler, Craig, Ziegler, & Charach, 1994; Roland, 2000); in effect, they appear to teach adolescents new methods for harming each other.

Explanations for Null or Negative Effects of Interventions

Why are many interventions ineffective? And why do some interventions seem to cause harm? Numerous explanations have been proposed. One frequent explanation is that such extensive efforts are not enough—that the problematic behaviors targeted by the intervention are deep-seated and require longer, more comprehensive treatments. Although this would explain the null findings, they do not explain the negative effects of several interventions. Moreover, as documented below, smaller but more targeted interventions frequently have sustained positive effects even when "larger" interventions have been ineffective (Miller & Prentice, in press; for examples in the academic domain, c.f. Yeager & Walton, 2011).

Another explanation is that when interventions involve lessons, moral appeals, direct persuasion, and explicit rehearsing of artificial scenarios, they can seem heavy-handed to adolescents. As a result, they run the risk of making the given moral habit seem externally imposed and outside of a student's own identity. This has the potential to undermine internalization and shorten the effect of an intervention. That is, when students leave the classroom or moral education setting and are with their peers or at home, they may be less likely to employ the targeted behavior or strategy if they were only endorsing it out of compliance to the teacher's appeals and not due to a personal decision. To the extent that adolescents adopt an oppositional identity, a heavy-handed intervention may even increase their motivation to reject its message. Alternatively, even among adolescents who change their behavior in the short term, they may also come to believe that they could only maintain a level of moral behavior while the intervention persists, and abandon it once the intervention ends. Overall, these possibilities potentially create an ironic position for moral character educators: the more persuasive, direct, and powerful a lesson, the more likely it may be to have only short-term effect, if any at all.

Failed interventions may also be limited when they are transparent to the student and to the teacher. When the goal of the activity or lesson is clearly to help them do more of a given moral behavior or have more of a given character trait, it could be offensive to adolescents if it implied that they are in need of a change in their moral behavior. For other adolescents, offers of help could be stigmatizing and reinforce negative stereotypes. Indeed, past efforts to improve the achievement of African American students have documented that framing assistance as remedial can undermine its effectiveness, while framing it as honorific or neutral can increase its effectiveness (e.g., Steele, 1997; Treisman, 1985). Indeed, evidence increasingly suggests that moral character education is not as straightforward as the teaching of math or history content. In general, the more math or history a student is taught, the more they learn. But the teaching of moral character may require a lighter, more nuanced touch.

It should be noted, however, that if traditional heavy-handed and transparent delivery mechanisms of MCE are problematic because they threaten adolescent autonomy and potentially stigmatize students, then these traditional interventions might be less effective for adolescents than they are for children, who are less vigilant to stigma (Brown & Bigler, 2005) and who have different identity and autonomy concerns than adolescents (Erikson, 1968). In fact, a series of recent meta-analyses of interventions to reduce bullying follow this trend: anti-bullying programs that explicitly teach character traits such as respect an empathy are frequently successful for younger children, but as children age and increase in autonomy these interventions are, in general, less effective (Fossum, Handegård, Martinussen, & Mørch, 2008; Merrell, Gueldner, Ross, & Isava, 2008; Smith, Schneider, Smith, & Ananiadou, 2004; Vreeman & Carroll, 2007; Wilson & Lipsey, 2007). In some regards, age differences may explain why some of the MCE programs reviewed in the previous section documented effectiveness, while others did not. Indeed, one important area for future research is to explicitly test whether developmental and individual differences in autonomy will explain the differential effectiveness of traditional interventions.

Additional research finds that moral character education interventions can unintentionally create bonds between peers who share knowledge or motivation about a negative behavior, and these bonds can in turn reinforce the peers' behaviors rather than prevent them. This idea, called *deviancy training* or *iatrogenic effects* is especially relevant for the Cambridge-Somerville study (Dishion & Tipsord, 2011), and is a danger any time an MCE program involves group activities or off-site retreats for small, targeted groups of at-risk peers. In the Cambridge-Somerville study, by sending boys at high risk for conduct problems to summer camps together, it may have created social ties between them and therefore created more opportunities for them to share techniques for rule-breaking (McCord 2003). A large number of subsequent studies that have analyzed adolescents' social networks have shown that problem behaviors are "contagious" (Dishion & Tipsord, 2011), and that interventions can accelerate their transmission. For instance, Valente et al. (2007) conducted a peer-led substance use (alcohol and drugs) reduction intervention among adolescents. The authors found that it increased substance among students who had friends who used those substances, while it decreased substance use among those who had social networks that did not include substance users (Valente et al., 2007). As happens with any contagion, an intervention that creates sustained contact between participants can have the effect of spreading negative outcomes. For this reason, Dodge, Dishion, and Lansford (2006) argued that interventions should be evaluated using randomized experiments, and that efforts should be taken to prevent deviancy training. This includes (a) delivering interventions to full classes of students instead of only "at-risk" participants (that is, universal interventions versus targeted interventions), and (b) reducing opportunities for unstructured or poorly supervised peer interactions during "group work" activities in interventions.

In sum, much research has assumed that as long as one knows what moral habit or skill to increase, then directly teaching it or trying to affect it will improve moral outcomes. But this is not always the case, especially for adolescents. Therefore, it is important to consider whether the delivery mechanisms used to teach moral character—rather than only the psychological target of such efforts—are likely to produce the intended change in the age group one is targeting. Next, we do so by comparing traditional intervention strategies to novel, or "stealthy" strategies.

Indirect or "Stealthy" Interventions

One can compare *traditional* moral character intervention strategies to what we call *indirect* or "stealthy" interventions. Traditional approaches often assume that an undesired behavior or a lack of a given character trait result because (a) people do not know the moral rule; (b) they know it but do not know how to do it; (c) they know it and know how, but do not want to. As a result, the intervention strategy is to teach knowledge directly; teach skills; or to make a persuasive appeal. Yet when none of these three factors are causes of a desired behavior, then an intervention strategy that may address them would not be expected to have an effect. Moreover, they may have the limitations noted above.

Other indirect or "stealthy" interventions rely on different assumptions and as a result use different strategies (Robinson, 2010; Yeager & Walton, 2011). Typically, indirect or "stealthy" interventions assume that (a) children or adolescents at some level know right from wrong and want to do what is right, but (b) critical barriers—such as one's beliefs—restrain their behavior and keep them from acting on their knowledge and motivation. Indirect interventions are designed to remove these barriers using brief changes to the subjective psychological context. They have the advantage of being "small" and minimally invasive, which is useful for promoting internalization, avoiding stigmatization, and preventing deviancy training. By avoiding direct persuasion and instead harnessing and re-directing the forces already acting on an adolescent's behavior, they may produce more lasting behavior change (Miller & Prentice, in press; Ross & Nisbett, 1991).

This approach has been used in many past interventions (e.g., Miller & Prentice, in press). In a classic study on decreasing classroom littering among fifth grade students, Miller, Brickman, and Bolen (1975) pitted direct persuasion against a stealthy approach. They theorized that if teachers told children directly to not litter this might reduce their littering in the short term, but it would also lead students to attribute their reduced littering to a teacher's influence and not to their own decisions. As a result, after the persuasion wore off students might return to their previous level of littering soon after the intervention. On the other hand, if students were led to see themselves as "nonlitterers" from the outset, then they might reduce their littering both in the short term and over time. Miller et al. (1975) showed that compared to a neutral control group, students in the direct persuasion condition did reduce their littering immediately, but two weeks later they had returned to preintervention levels. A group that was led to see themselves as "nonlitterers," however, reduced their littering both in the short term and over two weeks.

A more recent "stealthy" intervention approach is illustrated by Yeager, Trzesniewski, and Dweck (in press), who conducted an intervention to reduce aggression among low-income, diverse high school students. The intervention built on past theory, which suggested that adolescents will be more likely to choose aggression when they believe that people's traits are fixed, called an *entity theory* of personality (Yeager, Trzesniewski, Tirri, Nokelaninen, & Dweck, 2011). When adolescents hold this fixed entity theory, they are more likely to conclude that the peers who upset them did so because they have flawed traits—that they are "bad people" who can never change. In this mind-set, they feel that vengeance is a satisfying way to solve conflicts. When adolescents are taught that people can change, called an *incremental theory*, however, then vengeance seems less satisfying and prosocial behavior such as confronting problems directly or educating a transgressor is more appealing (Yeager, Trzesniewski, Tirri, et al., 2011).

Yeager et al. (in press) delivered a relatively brief but targeted universal classroom intervention that aimed to shift students' beliefs about the malleability of people's traits toward more of an incremental theory. The incremental theory intervention lasted six class sessions and included scientific information about how the brain works and changes, how the brain controls people's behavior, and how people's behaviors and characteristics can change when the brain changes. Yeager et al. (2011) presumed that students at some level knew that aggression was not a positive method for solving problems, but students' fixed entity theories about people's traits were a critical barrier preventing them from putting that knowledge into practice. Results supported this notion. Compared to a control group who were taught social emotional coping skills and a no-treatment control group, the incremental theory intervention reduced aggressive responses to a peer provocation by 40%, it increased prosocial responses to provocation by more than 200%, and it led students to be more likely to be nominated by teachers for improved behavior in school. Even though Yeager et al.'s (in press) intervention did not explicitly teach or endorse moral behaviors, it impacted a psychological barrier to moral character and resulted in changed behavior.

Notably, in the case of Yeager et al.'s (in press) intervention, the desired behavior was a side effect of the intervention, not an explicit target. Because the intervention did not directly target moral character, this leads to important questions about whether such interventions can truly be considered "moral character education," despite its effectiveness.

CONCLUSION AND IMPLICATIONS

Moral character can undoubtedly be learned. Just as children with no direct instruction learn the complexities of grammar and syntax, allowing them to produce infinite sets of utterances, even young infants with no explicit teaching can learn to prefer morality and goodness over immorality and badness (e.g. Hamlin, Wynn, & Bloom, 2007), and these judgments form the basis of a complex moral life over the course of development. In some regard, the story of moral character education is the story of the human experience of apprenticeship in the implicit curriculum of culture, and much of which happens without intentional intervention by well-meaning adults.

However, in this chapter we have not concerned ourselves with the question of whether moral character can be *learned*: Instead, we have turned our attention to whether it can be *taught*. That is, given that parents, teachers, and youth workers have explicit goals for children and adolescents' moral lives, what can be done to produce the desired outcomes? And it is this question that has produced volumes of empirical work but, unfortunately, mixed results.

We have seen that whether one has a positive or pessimistic view about the efficacy of MCE depends largely on how one defines it. When MCE is defined in a nonexpansive, narrow way, and when moral character is an explicit target of a program or intervention, then cause for optimism is slight. When MCE is defined in an expansive, broad way to include programs or interventions that target a wide range of psychosocial competencies, risk reduction or prevention, health promotion or achievement outcomes, then cause for optimism is warranted. As we have stated, this latter approach does not insist that the effective program include the language of morality, virtues, or character. It will be important going forward to continue to ask: What would it mean if amoral interventions (those that do not mention virtue, morality, or character) produce more ethical behavior than explicitly moral ones?

It is an open question whether MCE should be considered a curricular program—a worksheet or a lesson plan—or a set of pedagogical practices that are woven into conventional instruction. Put differently: If a school district takes seriously the educational mission of forming students with ethical character, does it look for a "program" to fit in the curriculum? If MCE is best considered a programmatic intervention then there are lessons to be learned about effective implementation from the risk, resilience, and prevention literatures. It must be guided by explicit theory. It must be comprehensive. It must involve multiple components, be initiated early in development and sustained over time. The work of the Seattle Social Development Program is a good example of this.

One advantage of programmatic approaches is that it treats seriously the requirement that MCE be addressed with intentional transparency, that it not be left to the hidden curriculum. If it is a topic of educational focus then it is presumed to require a formal curriculum. One drawback of programmatic approaches to MCE is that it treats MCE as a specialized curriculum that potentially isolates it from the rest of the instructional day. If a program involves radical reform of school structure and processes, as in the just community, or is otherwise intensive or intrusive on the school day, then its application becomes onerous and unfeasible and unlikely to be sustained over time. Moreover, the history of school reform teaches us that the effect of any standardized curriculum is bound to vary considerably across contexts and implementations: Variability is the norm, not the exception (Bryk, 2009). Additionally, as noted earlier, explicit instruction in morality or character has the potential to stigmatize students by suggesting that they lack it (Yeager & Walton, 2011), a barrier that any curriculum must face.

On the other hand, perhaps MCE should not be conceptualized as a discrete object—a formal program or specialized curriculum. Intentional commitment to pedagogical *practices* (rather than programs) can also produce character outcomes. As we have seen, there is compelling evidence that classrooms and schools that cultivate a sense of community and school connectedness have students who embrace prosocial values, persist in school, get better grades, and resist risk behavior (Monahan, Oesterle, & Hawkins, 2010; Osterman, 2000). One does not have to turn the entire school into a just community for teachers to hold class meetings or to communicate caring and respect.

School practices associated with school connectedness include teachers' positive classroom management, opportunities to participate in extracurricular activities and tolerant disciplinary practices (McNeely, Nonnemaker, & Blum, 2002). The National Research Council and Institute of Medicine (2004) recommend numerous practices to increase student connectedness to school, including high academic standards, a core curriculum for everyone, a de-emphasis on vocational and academic tracking, individualized advising and mentorship, and opportunities for service learning and community service. Similarly, the Eleven Principles of Character Education articulated by the Character Education Partnership provide guideposts that point not in the direction of specialized curricula but instead toward *ordinary best instructional practice* as the crucial element of effective character education.

It might not always be clear, then, what is and is not MCE, whether it is a treatment or outcome whether it is expansive or nonexpansive, intentional or stealthy, a program or practice. But the loss of conceptual distinctiveness for character education is offset by the gain in instructional clarity for practitioners (Lapsley & Narvaez, 2006). The problem for the teacher is not one of knowing which program "works" or of correctly labeling curricular and programmatic activities, but of mastering the instructional best practices that are common to all of them (the same point has been made with respect to promoting resilience, see Howard, Dryden, & Johnson, 1999).

This raises a final point, which concerns teacher formation for MCE. Nothing important happens in schools unless teachers do it. Although some elementary school teachers (particularly those who attended private religious schools of education) feel well equipped to take on MCE in the classroom (Milson & Mehlig, 2002), there is widespread recognition that preservice teacher education programs give scant attention to MCE (Jones, Ryan, & Bohlin, 1999; Revell & Arthur, 2007; Schwartz, 2008). One reason is simply the daunting surfeit of training objectives that already crowd the academic curriculum of teaching majors. Narvaez and Lapsley (2008) suggested two alternatives for teacher education that map onto the distinctions here regarding kinds of MCE. A minimalist strategy assumes that best practice instruction is sufficient for moral character formation. That is, the knowledge base that supports best practice teaching is coterminous with what is known to influence the moral formation of students. Schooling and teacher practices that promote achievement overlap with practices that support student prosocial development. Making explicit this linkage should be a clear goal for teacher education.

The clear goal is to adopt a best-practice approach to instruction for MCE. Of The minimalist strategy assumes that MCE is mostly about pedagogical practices and not implementation of programs. And it insists that becoming an effective character educator does not require a substantially larger or different tool box of instructional practices than is what is required to be an effective educator. That said, teacher educators should help preservice teachers understand how and where moral values permeate classrooms and schools, and help them understand, too, that hiding values under the blanket of instructional best practice does not relieve them of their moral duty as educators or evades the fundamentally moral purpose of education (Narvaez & Lapsley, 2008). Put differently, all of the 11 CEP principles of character education point to instructional best practice except one—the first principle—which draws attention to the fundamental importance of core values, but this principle might be the most important one in our zeal to train effective teachers for the cause of MCE.

The maximalist strategy assumes that MCE is mostly about programs, and that such programs are needed more than ever because of the broad changes in the way youngsters are raised in contemporary culture. Whereas the first option requires only reflective intentionality about the dual implications of best practice instruction (e.g., that it advances both academic achievement and moral character formation), the second option views best practice training as necessary but not sufficient (Narvaez & Lapsley, 2008). It is not sufficient because the conditions of modern child rearing are such that there is no guarantee that students will experience positive moral formation outside of school given the incidence of disconnected families and disordered communities. Increasingly schools are called on to compensate for socialization experiences gone awry in families and neighborhoods. Hence, there is an argument for designing and implementing formal school-based programs for MCE.

Darcia Narvaez argues for an approach called Integrative Ethical Education (IEE) as one such option (Narvaez, 2005, 2006; Narvaez, Bock, & Endicott, 2003; Narvaez, Bock, Endicott, & Lies, 2004). IEE is guided by key findings from educational science with respect to expertise development, and includes five key steps: (1) establish caring classroom community; (2) foster a supportive climate for moral behavior and high achievement; (3) cultivate ethical skills; (4) use an apprenticeship approach to instruction (i.e., novice-to-expertise guided practice); (5) develop self-regulation skills. The first two steps (and possibly Step 4, if understood as the zone-of-proximal development) are already included in the suite of skills of the best practice instructor. The remaining steps are rooted in the four component model of moral functioning and expertise development (Narvaez & Rest, 1995).

The first component (Ethical Sensitivity) concerns the ability to perceive the dilemmatic features of our experience, to notice the need for moral action ("Knowing *that*"). The second component (Ethical Judgment, Reasoning and Decision Making) concerns reasoning about what to do and which response is just or fair ("Knowing *what*"). The third component concerns moral motivation or moral focus. It connects our moral judgment with our moral desire to be a person of a certain kind ("Knowing *why*"). The fourth component (Ethical Action) concerns how to put into practice the outcome of moral judgment and desiring. It concerns the sort of implementation skills that Blasi (2005) calls *willpower* (self-control) and Davidson et al. (2008) call *performance character*. Within each component are a suite of relevant skills for which IEI provides a set of curricular activities by which to hone them to higher levels of expertise (Narvaez, Mitchell, Endicott, & Bock, 1999).

Whether the framework is CEP principles or the four components of IEE, these will have to find a place in the teacher education curriculum. Berkowitz (1999) suggested a course of study or preservice mentorship that focuses on developing character knowledge, skill acquisition, and values. This requires teacher education faculty, or at least specialist faculty, who are knowledgeable about moral character and who believe it important enough to build into the teacher formation curriculum. We would take this one step further. It may turn out that the most important component of teacher education is the presence of moral candidates to begin with. Put differently, the best prospect for MCE in the schools may lie in the selection and recruitment of teacher education candidates who possess the moral mindsets to become effective teachers in the schools. This would seem to be an exciting target of future research

REFERENCES

Abbott, R. D., O'Donnell, J., Hawkins, J. D., Hill, K. G., Kosterman, R. & Catalano, R. F. (1998). Changing teaching practices to promote achievement and bonding to school. *American Journal of Orthopsychiatry, 68*, 542–552.

Anderman, E. M. (2002). School effects on psychological outcomes during adolescence. *Journal of Educational Psychology, 94*, 795–809.

Anderson, L. M. (1989). Learners and learning. In M. C. Reynolds (Ed.), *Knowledge base for the beginning teacher* (pp. 85–99). Oxford, UK: Pergamon Press.

Andrews, J. A., Hampson, S. & Peterson, M. (2011). Early adolescent cognitions as predictors of heavy alcohol use in high school. *Addictive Behavior, 36*, 448–455.

Annas, J. (2011). *Intelligent virtue*. Oxford, UK: Oxford University Press.

Arsenio, W., & Lover, A. (1995). Children's conceptions of socio-moral affect: Happy victimizers, mixed emotions and other expectancies. In M. Killen & D. Hart (Eds.), *Morality in everyday life* (pp. 87–130). New York, NY: Cambridge University Press.

Ayer, A. J. (1952). *Language, truth and logic*. New York, NY: Dover.

Baer, R. (1993). "Strict neutrality" and our monopoly system. In J. W. Skillen (Ed.), *The school choice controversy: What is constitutional?* (pp. 3–20). Grand Rapids, MI: Baker Books.

Bartsch, K. & Wright, J. (2005). Toward an intuitionist account of moral development, *Behavioral and Brain Sciences, 28*(4), 546–547.

Battistich, V. (2008). The child development project: Creating caring school communities. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 328–351). New York, NY: Routledge.

Battistich, V., Solomon, D., Watson, M., & Schaps, E. (1996). *Enhancing students' engagement, participation and democratic values and attitudes*. Ann Arbor, MI: Society for the Psychological Study of Social Issues.

Battistich, V., Solomon, D., Watson, M., & Schaps, E. (1997). Caring school communities. *Educational Psychologist, 32*, 137–151.

Battistich, V., Solomon, D., Watson, M., Solomon, J., & Schaps, E. (1989). Effects of an elementary school program to enhance prosocial behavior on children's social problem-solving skills and strategies. *Journal of Applied Developmental Psychology, 10*, 147–119.

Bebeau, M. J., & Monson, V. E. (2008). Guided by theory, grounded in evidence: A way forward for professional ethics education. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 557–582). New York, NY: Routledge.

Beland, K. (2003, Series Ed.) *Eleven principles sourcebook: How to achieve quality character education in K-12 schools*. Washington, DC: Character Education Partnership.

Berkowitz, M. W., Sherblom, S. A., Bier, M. C. & Battistich, V. (2006). Educating for positive youth development. In M. Killen & J. G. Smetana (Eds.), *Handbook of moral development* (pp. 683–701). Mahwah, NJ: Erlbaum.

Berkowitz, M., & Gibbs, J. (1983). Measuring the developmental features of moral discussion. *Merrill-Palmer Quarterly, 29*, 399–410.

Berkowitz, M., Gibbs, J., & Broughton, J. M. (1980). The relation of moral judgment stage disparity to developmental effects of peer dialogues. *Merrill-Palmer Quarterly, 26*, 341–357.

Berkowitz, M., & Grych, J. H. (2000). Early character development and education. *Early Education and Development, 11*, 55–72.

Berkowitz, M. W. (1999). Building a good person. In M. W. Williams & E. Schaps (Eds.), *Character education: The foundation for teacher* *education: Report of the national commission on character education* (pps. 19–23). Washington, DC: Character Education Partnership.

Berkowitz, M. W. (2000). Civics and moral education. In B. Moon, S. Brown, & M. Ben-Peretz (Eds.), *Routledge international companion to education* (pp. 897–909). New York, NY: Routledge.

Berkowitz, M. W. (2002). The science of character education. In W. Damon (Ed.), *Bringing in a new era in character education* (pp. 43–63). Stanford, CA: Hoover Institution Press.

Berkowitz, M. W., Battistich, V. A., & & Bier, M. C. (2008). What works in character education: What is known and what needs to be known. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 414–431). New York, NY: Routledge.

Berkowitz, M. W., & Bier, M. (2004). *What works in character education: A research-driven guide for educators*. Washington, DC: Character Education Partnership.

Berkowitz, M. W., & Simmons, P. (2003). Integrating science education and character education: The role of peer discussion. In D. L. Zeidler (Ed.), *The role of moral reasoning on socioscientific issues and discourse in science education* (pp. 117–138). Dordrecht, The Netherlands: Kluwer.

Berkowitz, M. W., Vincent, P. F. & McKay, L. (2002). What should be the role of the community in character education? *The School Public Relations Journal, 22*, 4–14.

Blasi, A. (1984). Moral identity: Its role in moral functioning. In W. M. Kurtines & J. J. Gewirtz (Eds.), *Morality, moral behavior and moral development* (pp. 128–139). New York, NY: Wiley.

Blasi, A. (1988). Identity and the development of the self. In D. K. Lapsley & F. C. Power (Eds.), *Self, ego and identity: Integrative approaches* (pp. 226–242). New York, NY: Springer-Verlag.

Blasi, A. (1993). The development of identity: Some implications for moral functioning. In G. G. Noam & T. E. Wren (Eds.), *The moral self* (pp. 99–122). Cambridge, MA: MIT Press.

Blasi, A. (2005). Moral character: A psychological approach. In D. K. Lapsley & F. C. Power (Eds.), *Character psychology and character education* (pp. 18–35). Notre Dame, IN: University of Notre Dame Press.

Blatt, M., & Kohlberg, L. (1975). The effect of classroom discussion upon children's moral judgment. *Journal of Moral Education, 4*, 129–161.

Blum, R. W. (2005). A case for school connectedness. *Educational Leadership, 62*, 16–20.

Bond, L., Butler, H., Dip, G., Thomas, L., Carlin, J., Glover, S., . . . Patton, G. (2007). Social and school connectedness in early secondary school as predictors of late teenage substance use, mental health and academic outcomes. *Journal of Adolescent Health, 40*, 35.

Brandenberger, J. (2005). College, character and social responsibility: Moral learning through experience. In D. K. Lapsley & F. C. Power (Eds.), *Character psychology and character education*. Notre Dame, IN: University of Notre Dame Press.

Brown, C. S., & Bigler, R. S. (2005). Children's perceptions of discrimination: A developmental model. *Child Development, 76*, 533–553.

Brooks, D. B., & Goble, F. G. (1997). *The case for character education: The role of the school in teaching values and virtues*. Northridge, CA: Studio 4.

Brugman, D., Podolskij, A. J., Heymans, P. G., Boom, J., Karabanova, O., & Idobaeva, O. (2003). Perception of moral atmosphere in school and norm transgressive behavior in adolescents: An intervention study. *International Journal of Behavioral Development, 27*, 389–400.

Bryk, A. (1988). Musings on the moral life of schools. *American Journal of Education, 96*, 256–290.

Bryk, A. S. (2009). Support a science of performance improvement. *Phi Delta Kappan*, *90*, 597–600.

Dodge, K. A., Dishion, T. J., & Lansford, J. E. (2006). Deviant peer influences in intervention and public policy for youth. *Social Policy Report*, *20*, 3–19.

Carr, D. (1991). *Educating the virtues: An essay on the philosophical psychology of moral and education*. London, UK: Routledge.

Catalano, R. F., Berglund, M. L., Ryan, J. A. M., Lonczak, H. S., & Hawkins, D. J. (2004). Youth development in the United States: Research findings on evaluations of positive youth development. *Annals of the American Academy of Political and Social Science*, *591*, 98–124.

Catalano, R. F., Haggerty, K. P., Oesterle, S., Fleming, C. B., & Hawkins, J. D. (2004). The importance of bonding to school for healthy development: Findings from the social development research group. *Journal of School Health, 74* (7), 252–261.

Catalano, R. F., Hawkins, D. J., & Toumbourou, J. W. (2008). Positive youth development in the United States: History, efficacy and links to moral and character education. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 459–483). New York, NY: Routledge.

Cervone, D., & Shoda, Y. (1999). (Eds.). *The coherence of personality: Social-cognitive bases of consistency, variability and organization*. New York, NY: Guilford Press.

Chapman, M. (1988). *Cognitive evolution: Origin and development of Piaget's thought*. Cambridge, UK: Cambridge University Press.

Colby, A., Ehrlich, T., Beaumont, A. & Stephens, J. (2003). *Educating citzens: Preparing America's undergraduates for lives of moral and civic responsibility*. NY: Jossey-Bass.

Colby, A., & Damon, W. (1992). *Some do care: Contemporary lives of moral commitment*. New York, NY: Free Press.

Colby, A., & Damon, W. (1995). The development of extraordinary moral commitment. In M. Killen & D. Hart (Eds.), *Morality in everyday life: Developmental perspectives* (pp. 342–370). Cambridge, UK: Cambridge University Press.

Colby, A., Kohlberg, L., Gibbs, J., & Lieberman, N. (1983). A longitudinal study of moral judgment. *Monographs of the Society for Research in Child Development*, *48* (1–2, Serial No. 200).

Cowie, H., & Olafsson, R. (2000). The role of peer support in helping the victims of bullying in a school with high levels of aggression. *School Psychology International, 21*, 79–95.

Cunningham, C. A. (2005). A certain and reasoned art: The rise and fall of character education in America. In D. K. Lapsley & F. C. Power (Eds.), *Character psychology and character education* (pp. 166–200). Notre Dame, IN: University of Notre Dame Press.

Davidson, M., Lickona, T., & Khmelkov, V. (2008). Smart and good schools: A new paradigm for high school character education. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 370–390). New York, NY: Routledge.

Davis, M. (2003). What's wrong with character education? *American Journal of Education, 110*, 32–57.

DeSouza, E. R., & Ribeiro, J. (2005). Bullying and sexual harassment among Brazilian high school students. *Journal of Interpersonal Violence, 20*, 1018–1038.

DeVries, R., & Zan, B. (1994). *Moral classrooms, moral children: Creating a constructivist atmosphere in early education*. New York, NY: Teachers College Press.

Dewey, J. (1908). *Moral principles in education*. Boston, MA: Houghton-Mifflin.

Dishion, T. J., McCord, J., & Poulin, F. (1999). When interventions harm: Peer groups and problem behavior. *American Psychologist, 54*, 755–754.

Dishion, T. J., & Tipsord, J. M. (2011). Peer contagion in child and adolescent social and emotional development. *Annual Review of Psychology, 62*, 189–214.

Dodge K. A., Dishion, T. J., & Lansford J. E. (2006). Deviant peer influences in intervention and public policy for youth. *Social Policy Report, 20*, 3–19.

Durkheim, E. (1925). *Moral education: A study in the theory and application of the sociology of education*. New York, NY: Free Press.

Elias, M. J., Parker, S. J., Kash, M. V., Weissberg, R. P., & O'Brien, M. U. (2008). Social and emotional learning, moral education and character education: A comparative analysis and a view toward convergence. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 248–266). New York, NY: Routledge.

Etzioni, A. (1996). *The new golden rule*. New York, NY: Basic Books.

Erikson, E. H. (1968). *Identity: Youth and crisis*. New York, NY: Norton.

Featherstone, J. A. (1986). Foreword. In B. A. Kimball, *Orators and philosophers: A history of the idea of liberal education* (pp. ix–xiv). New York, NY: Teachers College Press.

Flanagan, C. (2004). Volunteerism, leadership, political socialization and civic engagement. In R. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., pp. 721–746). Hoboken, NJ: Wiley.

Flanagan, O., & Rorty, A. (Eds.). (1990). *Identity, character and morality: Essays in moral psychology*. Cambridge, MA: MIT Press.

Fossum, S., Handegård, B. H., Martinussen, M., & Mørch, W. T. (2008). Psychosocial interventions for disruptive and aggressive behaviour in children and adolescents: A meta-analysis. *European Child and Adolescent Psychiatry, 17*, 438–451.

Frimer, J. A., & Walker, L. J. (2009). Reconciling the self and morality: An empirical model of moral centrality development. *Developmental Psychology, 45*, 1669–1681.

Goodlad, J. (1992). The moral dimension of schooling and teacher education. *Journal of Moral Education, 21*, 87–98.

Goodman, J., & Lesnick, H. (2001). *The moral stake in education: Contested premises and practices*. New York, NY: Longman.

Gordon, M. (2005). *Roots of empathy: Changing the world child by child.* Toronto, Canada: Thomas Allen.

Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature. 450*, 557–559.

Hanewinkel, R. (2004). Prevention of bullying in German schools: An evaluation of an anti-bullying approach. In P. K. Smith, D. Pepler, & K. Rigby (Eds.), *Bullying in schools: How successful can interventions be?* (pp. 81–97). Cambridge, UK: Cambridge University Press.

Hansen, D. T. (1993). From role to person: The moral layeredness of classroom teaching. *American Educational Research Journal, 30*, 651–674.

Hardy, S. & Carlo, G. (2005). Identity as a source of moral motivation. *Human Development, 48*, 222–256.

Hart, D. (2005). The development of moral identity. *Nebraska Symposium on Motivation, 51*, 165–196.

Hart, D., & Fegley, S. (1995). Prosocial behavior and caring in adolescence: Relations to self understanding and social judgment. *Child Development, 66*, 1346–1359.

Hart, D., Matsuba, K., & Atkins, R. (2008). The moral and civic effects of learning to serve. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 484–499). New York, NY: Routledge.

Hartshorne, H., & May, M. A. (1928–1930). *Studies in the nature of character*. *Vol. 1: Studies in deceit* (Vol. 2, with J. B. Maller, 1929), *Studies in service and self-control*. (Vol. 3, with F. K. Shuttleworth, 1930), *Studies in the organization of character*. New York, NY: Macmillan.

Hawkins, D. J., Catalano, R. F., Kosterman, R., Abbott, R., & Hill, K. G. (1999). Preventing adolescent health-risk behavior by strengthening protection during childhood. *Archives of Pediatrics and Adolescent Medicine, 153*, 226–234.

Hawkins D. J., Guo J., Hill, K. G., Battin-Pearson, S., & Abbott R. D. (2001). Longterm effects of the Seattle Social Development intervention on school bonding trajectories. *Applied Developmental Science,* 225–236.

Hay, D. F., Castle, J., Stimson, C. A., & Davies, L. (1995). The social construction of character in toddlerhood. In M. Killen & D. Hart (Eds.), *Morality in everyday life: Developmental perspectives* (pp. 23–51). Cambridge, UK: Cambridge University Press.

Horn, S. S. (2003). Adolescents' reasoning about exclusion from social groups. *Developmental Psychology, 39*, 71–84.

Horn, S. S. (2006). Group status, group bias and adolescents' reasoning about the treatment of others in school context. *International Journal of Behavioral Development, 30*, 208–218.

Horn, S. S. (2007). Adolescents' acceptance of same-sex peers based on sexual orientation and gender expression. *Journal of Youth and Adolescence, 32*, 363–371.

Horn, S. S., Daddis, C., & Killen, M. (2008). Peer relationships and social groups: Implications for moral education. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 267–287). New York, NY: Routledge.

Horn, S. S., Killen, M., & Stangor, C. S. (1999). The influence of group stereotypes on adolescents' moral reasoning. *Journal of Early Adolescence, 19*, 98–113.

Host, K., Brugman, D., Tavecchio, L., & Breem, L. (1998). Students' perception of the moral atmosphere in secondary schools and the relationship between moral competence and moral atmosphere. *Journal of Moral Education, 27*, 47–71.

Howard, S., Dryden, J., & Johnson, B. (1999). Childhood resilience: Review and critique of literature. *Oxford Review of Education, 25*(3), 307–323.

Hursthouse, R. (1999). Normative virtue ethics. In S. Darwall (Ed.), *Virtue ethics* (pp. 184–202). Oxford, UK: Blackwell.

Jackson, P. W., Boostrom, R. E., & Hansen, D. T. (1993). *The moral life of schools*. San Francisco, CA: Jossey-Bass.

Jacobson, D. (2005). Seeing by feeling: Virtues, skills and moral perception. *Ethical Theory and Moral Practices, 8*(2), 387–409.

Jones, E. N., Ryan, K., & Bohlin K. (1999). *Teachers as educators of character: Are the nation's schools of education coming up short?* Washington, DC: Character Education Partnership.

Kaiser-Ulrey, C. (2003). Bullying in middle school: A study of B.E.S.T. (bullying eliminated from schools together) an anti-bullying program for seventh grade students. Unpublished doctoral dissertation, Florida State University, Tallahassee.

Keefer, M. W. (2006). A critical comparison of classical and domain theory: Some implications for character education. *Journal of Moral Education, 35*, 369–386.

Killen, M., Breton, S., Ferguson, H., & Handler, K. (1994). Preschoolers' evaluations of teacher methods of intervention in social transgressions. *Merrill-Palmer Quarterly, 40*, 399–415.

Killen, M., Lee-Kim, J., McGlothlin, H., & Stangor, C. (2002). How children and adolescents evaluate gender and racial exclusion. *Monographs for the society for research in child development* (Serial No. 271, Vol. 67, No. 4). Oxford, UK: Blackwell.

Killen, M., & Stangor, C. (2001). Children's reasoning about social inclusion and exclusion in gender and race peer group contexts. *Child Development, 72*, 174–186.

Killen, M., Stangor, C., Price, B. S., Horn, S. S., & Sechrist, G. (2004). Social reasoning about racial exclusion in intimate and nonintimate relationships. *Youth and Society, 35*, 293–322.

Kimball, B. A. (1986). *Orators and philosophers: A history of the idea of liberal education*. New York, NY: Teachers College Press.

Kochanska, G. (1997). Mutually-responsive orientation between mothers and their children: Implications for socialization. *Child Development, 68*, 94–112.

Kochanska, G. (2002). Committed compliance, moral self and internalization: A mediated model. *Developmental Psychology, 38*, 339–351.

Kochanska, G. & Aksan, N. (2004). Conscience in childhood: Past, present and future. *Merrill-Palmer Quarterly, 50*, 299–310.

Kochanska, G., Aksan, N., Prisco, T. R., & Adams, E. E. (2008). Mother-child and father-child mutually responsive orientation in the first two years and children's outcomes at preschool age: Mechanisms of influence. *Child Development, 79*, 30–44.

Kochanska, G., Forman, D. R., Aksan, N., & Dunbar, S. B. (2005). Pathways to conscience: Early mother child mutually-responsive orientation and children's moral emotion, conduct and conduct. *Journal of Child Psychology and Psychiatry, 46*, 19–34.

Kohlberg, L. (1969). Stage and sequence: The cognitive developmental approach to socialization. In D. A. Goslin (Ed.), *Handbook of socialization theory and research* (pp. 347–480). Chicago, IL: Rand McNally.

Kohlberg, L. (1973). Continuities in childhood and adult moral development research. In P. B. Baltes & K. W. Schaie (Eds.), *Lifespan developmental psychology: Personality and socialization*. New York, NY: Academic Press.

Kohlberg, L. (1984). Moral stages and moralization: The cognitive developmental approach. In L. Kohlberg, *The psychology of moral development: The nature and validity of moral stages* (pp. 170–205). San Francisco, CA: Harper & Row.

Kohlberg, L. (1985). The just community approach to moral education in theory and practice. In M. Berkowitz & F. Oser (Eds.), *Moral education: Theory and application* (pp. 27–86). Hillsdale, NJ: Erlbaum.

Kohlberg, L. (1987). *Child psychology and childhood education: A cognitive-developmental view.* New York, NY: Longman.

Kohlberg, L., & Kramer, R. (1969). Continuities and discontinuities in childhood and adult moral development. *Human Development, 12*, 93–120.

Kramer, R. (1968). *Moral development in young adulthood*. Unpublished doctoral dissertation, University of Chicago, Chicago, IL.

Kristjansson, K. (2002). In defense of "non-expansive" character education. *Journal of Philosophy of Education, 36*(2), 135–156.

Lapsley, D. K. (2006). Moral stage theory. In M. Killen & J. Smetana (Eds.), *Handbook of moral development* (pp. 37–66). Mahwah, NJ: Erlbaum.

Lapsley, D. K. (2008). Moral self-identity as the aim of education. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 30–52). New York, NY: Routledge.

Lapsley, D. K., & Hill, P. L. (2008). On dual processing and heuristic approaches to moral cognition. *Journal of Moral Education, 37*, 313–332.

Lapsley D. K., & Hill, P. (2009). The development of the moral personality. In D. Narvaez & D. K. Lapsley (Eds.), *Identity, personality and character: Explorations in moral psychology* (pp. 185–213). Cambridge, UK: Cambridge University Press.

Lapsley, D. K., & Narvaez, D. (2004). (Eds.). *Moral development, self and identity*. Mahwah, NJ: Erlbaum.

Lapsley, D. K., & Narvaez, D. (2006). Character education. In W. Damon & R. Lerner (Series Eds.), Renninger & I. Siegel (Vol. Eds.), *Handbook of child psychology*: *Vol. 4. Child psychology in practice* (6th ed., pp. 248–296). Vol. 4 in W. Damon & R. Lerner (Series Eds.), *Handbook of child psychology* (6th ed.). Hoboken, NJ: Wiley.

Lapsley, D. K., Enright, R. D., & Serlin, R. C. (1989). Moral and social education. In J. Worell & F. Danner (Eds.), *The adolescent as decision-maker: Applications to development and education* (pp. 111–141). San Diego, CA: Academic Press.

Lickona, T. (1991). *Educating for character: How our schools can teach respect and responsibility*. New York, NY: Bantam.

Lickona, T. (1997). Educating of character: A comprehensive approach. In A. Molnar (Ed.), *The construction of children's character* (pp. 45–62). Chicago, IL: University of Chicago Press.

Lickona, T., & Davidson, M. (2004). *Smart and good high schools: Developing excellence and ethics for success in school, work and beyond*. Cortland, NY: Center for the 4th and 5th Rs (Respect and Responsibility).

Lickona, T., Schaps, E., & Lewis, C. (2004). *The eleven principles of effective character education*. Washington, DC: Character Education Partnership.

Lies, J., Bronk, K. C., & Mariano, J. M. (2008). The community contribution to moral development and character. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 520–536). New York, NY: Routledge.

Lilienfeld, S. (2007). Psychological treatments that cause harm. *Perspectives on Psychological Science, 2*, 53–70.

Loukas, A., Ripperger-Suhler, K. G., & Horton, K. D. (2009). Examining temporal associations between school connectedness and early adolescent adjustment. *Journal of Youth and Adolescence, 38*, 804–812.

Loukas, A., Roalson, L. A., & Herrera, D. E. (2010). School connectedness buffers the effects of negative family relations and poor effortful control on early adolescent conduct problems. *Journal of Research on Adolescence, 20*, 13–22.

MacIntyre, A. (1981). *After virtue*. Notre Dame, IN: University of Notre Dame Press.

Matsuba, K., & Walker, L. J. (2004). Extraordinary moral commitment: Young adults in social organizations. *Journal of Personality, 72*, 413–436.

Matsuba, K., & Walker, L. J. (2005). Young adult moral exemplars: The making of self through stories. *Journal of Research on Adolescence, 15*, 275–297.

McAdams, D. (1993). *The stories we live by: Personal myths and the making of the self* . New York, NY: Guilford.

McAlaney, J., Bewick, B., & Hughes, C. (2011). The international development of the "social norms" approach to drug education and prevention. *Drugs: Education, Prevention & Policy, 18*, 81–89.

McClellan, B. W. (1999). *Moral education in America: Schools and the shaping of character from colonial times to the present.* New York, NY: Teachers College Press.

McCord, J. (1978). A thirty-year follow-up of treatment effects. *American Psychologist, 33*, 284–289.

McCord, J. (2003). Cures that harm: Unanticipated outcomes of crime prevention programs. *Annals of the American Academy of Political and Social Science, 587*, 16–30.

McLaughlin, T. H., & Halstead, J. M. (1999). Education in character and virtue. In J. M. Halstead & T. H. McLaughlin (Eds.), *Education in morality* (pp. 131–162). London, UK: Routledge.

McNeely, C. A., Nonnemaker, J. M., & Blum, R. W. (2002). Promoting school connectedness: Evidence from the national longitudinal study of adolescent health. *Journal of School Health, 72*, 138–146.

Merrell, K. W., Gueldner, B. A., Ross, S. W., & Isava, D. M. (2008). How effective are school bullying intervention programs? A meta-analysis of intervention research. *School Psychology Quarterly, 23*, 26–42.

Metropolitan Area Child Study Research Group. (2002). A cognitive-ecological approach to preventing aggression in urban settings: Initial outcomes for high-risk children. *Journal of Consulting and Clinical Psychology, 70*, 179–194.

Miller, D. T., & Prentice, D. A. (in press). Psychological levers of behavior change. In E. Shafir (Ed.), *Behavioral foundations of policy*. New York, NY: Sage.

Miller, R. L., Brickman, P., & Bolen, D. (1975). Attribution versus persuasion as a means for modifying behavior. *Journal of Personality and Social Psychology, 31*, 430–441.

Milson, A. J., & Mehlig, L. M. (2002). Elementary school teachers' sense of efficacy for character education. *Journal of Educational Research, 96*(1), 47–53.

Monahan, K. C., Oesterle, S., & Hawkins, J. D. (2010). Predictors and consequences of school connectedness: The case for prevention. *The Prevention Researcher, 17*(3), 3–6.

Monroe, L. (1994). But what else could I do? Choice, identity and a cognitive- perceptual theory of ethical political behavior. *Political Psychology, 15*, 201–226.

Monroe, L. (2001). Morality and the sense of self: The importance of identity and categorization for moral action. *American Journal of Political Science, 45*, 491–507.

Monroe, L. (2003). How identity and perspective constrain moral choice. *International Political Science Review, 24*, 405–424.

Nagel, T. (1979). *Mortal questions*. Cambridge, UK: Cambridge University Press.

Narvaez, D. (2005). The Neo-Kohlbergian tradition and beyond: Schemas, expertise and character. In G. Carlo & C. Pope-Edwards (Eds.), *Nebraska symposium on motivation, vol. 51: Moral motivation through the lifespan* (pp. 119–163). Lincoln, NE: University of Nebraska Press.

Narvaez, D. (2006). Integrative Ethical Education. In M. Killen & J. Smetana (Eds.), *Handbook of moral development* (pp. 703–733). Mahwah, NJ: Erlbaum.

Narvaez, D., Bock, T., Endicott, L., (2003). Who should I become? Citizenship, goodness, human flourishing and ethical expertise. In W. Veugelers & F. K. Oser (Eds.), *Teaching in moral and democratic education* (pp. 43–63). Bern, Switzerland: Peter Lang.

Narvaez, D., Bock, T., Endicott, L., & Lies, J. (2004). Minnesota's community voices and character education project. *Journal of Research in Character Education, 2*, 89–112.

Narvaez, D., & Lapsley, D. K. (2005). The psychological foundations of everyday morality and moral expertise. In D. K. Lapsley & F. C. Power (Eds.), *Character psychology and character education* (pp. 140–165). Notre Dame, IN: University of Notre Dame Press.

Narvaez, D., & Lapsley, D. K. (2008). Teaching moral character: Two alternatives for teacher education. *Teacher Educator, 43*(2), 156–172.

Narvaez, D., & Lapsley, D. K. (2009). Moral identity, moral functioning and the development of moral identity. In D. M. Bartels, C. W. Bauman, L. J. Skitka, & D. L. Medin (Eds), *Moral judgment and decision-making: The psychology of learning and motivation: Advances in research and theory* (pp. 237–274). San Diego, CA: Elsevier Academic Press.

Narvaez, D., Mitchell, C., Endicott, L., & Bock, T. (1999). *Nurturing character in the middle school classroom: A guidebook for teachers.* Minnesota, MN: Department of Children, Families, and Learning.

Narvaez, D., & Rest, J. (1995). The four components of acting morally. In W. Kurtines & J. Gewirtz (Eds.), *Moral behavior and moral development: An introduction* (pp. 385–400). New York, NY: McGraw-Hill.

National Research Council and Institute of Medicine. (2004). *Engaging schools: Fostering high school students' motivation to learn.* Washington, DC: National Academies Press.

Nicgorski, W., & Ellrod, F. E. (1992). Moral character. In G. F. McLean & F. E. Ellrod (Eds.), *Philosophical foundations for moral education and character development: Act and agent* (pp. 142–162). Washington, DC: Council for Research in Values and Philosophy.

Nucci, L. (1996). Morality and the personal sphere of actions. In E. S. Reed, E. Turiel, & T. Brown (Eds.), *Values and knowledge* (pp. 41–60). Hillsdale, NJ: Erlbaum.

Nucci, L. (2001). *Education in the moral domain*. Cambridge, UK: Cambridge University Press.

Nucci, L. (2004). Reflections on the moral self construct. In D. K. Lapsley & D. Narvaez (Eds.), *Moral development, self and identity* (pp. 111–132). Mahwah, NJ: Erlbaum.

Nucci, L. (2008). Social cognitive domain theory and moral education. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 291–309). New York, NY: Routledge.

Nucci, L., Guerra, N., & Lee, J. (1991). Adolescent judgments of the personal, prudential, and normative aspects of drug use. *Developmental Psychology*, *27*, 841–848.

Osterman, K. F. (2000). Students' need for belonging in the school community. *Review of Educational Research, 70*, 323–367.

Payne, A., Gottfredson, G. D., & Gottfredson, D. C. (2003). Schools as communities: The relationships among communal school organization, student bonding and school disorder. *Criminology, 41*, 749–778.

Pepler, D. J., Craig, W. W., Ziegler, S., & Charach, A. (1994). An evaluation of an anti-bullying intervention in Toronto schools. *Canadian Journal of Community Mental Health, 13*, 95–110.

Petrosino, A., Turpin-Petrosino, C., & Buehler, J. (2003). "Scared Straight" and other juvenile awareness programs for preventing juvenile delinquency. *Annals of the American Academy of Political and Social Science, 589*, 41–62.

Piaget, J. (1932). *The moral judgment of the child.* New York, NY: Free Press.

Power, F. C. (2004). Moral self in community. In D. K. Lapsley & D. Narvaez (Eds.), *Moral development, self and identity* (pp. 47–64). Mahwah, NJ: Lawrence Erlbaum Associates.

Power, F. C., Higgins, A., & Kohlberg L. (1989). *Lawrence Kohlberg's approach to moral education*. New York, NY: Columbia University Press.

Power F. C., & Higgins-D'Alessandro, A. (2008). The just community approach to moral education and the moral atmosphere of the school. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 230–247). New York, NY: Routledge.

Power, F. C., Sheehan, K. K., McCarthy, K., & Carnevale, T. C. (2010). Champions for children: Reaching out to urban youth through sports. *Journal of Research in Character Education, 8*(2), 75–85.

Reimer, K. (2003). Committed to caring: Transformation in adolescent moral identity. *Applied Developmental Science, 7*, 129–137.

Rest, J. R. (1985). Moral research methodology. In S. Modgil & C. Modgil (Eds.), *Lawrence Kohlberg: Consensus and controversy* (pp. 455–470). Philadelphia, PA: Falmer Press.

Rest, J. R. (1983). Morality. In J. H. Flavell & E. Markman (Eds.), *Handbook of child psychology Vol 3*. *Cognitive development* (4th ed.). New York, NY: Wiley.

Revell, L., & Arthur, J. (2007). Character education in schools and the education of teachers. *Journal of Moral Education, 36*, 79–92.

Rhule, D. M. (2005). Take care to do no harm: Harmful interventions for youth problem behavior. *Professional Psychology: Research and Practice, 36*, 618–625.

Rivers, T. M. (2004). Ten essentials for character education. *Journal of General Education, 53*, 247–260.

Robinson, T. N. (2010). Stealth interventions for obesity prevention and control: Motivating behavior change. In L. Dube, A. Bechara, A. Dagher, A. Drewnowski, J., Lebel, P., James, & R. Y. Yada (Eds.), *Obesity prevention: The role of brain and society on individual behavior.* New York, NY: Elsevier.

Roland, E. (2000). Bullying in school: Three national innovations in Norwegian schools in 15 years. *Aggressive Behavior, 26*, 135–143.

Ross, L., & Nisbett, R. E. (1991). *The person and the situation: Perspectives of social psychology.* New York, NY: McGraw-Hill.

Roth, J. L., & Brooks-Gunn, J. (2003). What exactly is a youth development program? Answers from research and practice. *Applied Developmental Science*, *7*, 94–111.

Ryan, K., & Bohlin, K. E. (1999). *Building character in schools: Practical ways to bring moral instruction to life*. San Francisco, CA: Jossey-Bass.

Ryan, K., & Lickona, T. (Eds.). (1992). *Character development in schools and beyond*. Washington, DC: Council for Research in Values and Philosophy.

Schaefli, A., Rest, J. R., & Thoma, S. J. (1985). Does moral education improve moral judgment? A meta- analysis of intervention studies using the Defining Issues Test. *Review of Educational Psychology, 55*, 319–352.

Schonert-Reichl, K. A., & Scott, F. (2005). Effectiveness of the "Roots of Empathy" program in promoting children's emotional and social competence: A summary of research outcome findings. In M. Gordon, *The roots of empathy: Changing the world child by child* (pp. 239–252). Toronto, Canada: Thomas Allen.

Schwartz, M. (2008). Teacher education for moral and character education. In L. Nucci & D. Narvaez (Eds.), *Handbook of* *moral and character education* (pp. 583–600). New York, NY: Routledge.

Sherman, N. (1997). *Making a necessity of virtue: Aristotle and Kant on virtue*. Cambridge, UK: Cambridge University Press.

Shields, D. L., & Bredemeier, B. L. (2005). Can sports build character? In D. K. Lapsley & F. C. Power (Eds.), *Character psychology and character education* (pp. 121–139). Notre Dame, IN: University of Notre Dame Press.

Shields, D. L., & Bredemeier, B. L. (2008). Sport and the development of character. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 500–519). New York, NY: Routledge.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*, 1–22.

Silvia, S., Blitstein, J., Williams, J., Ringwalt, C., Dusenbury, L., & Hansen, W. (2010). *Impacts of a violence prevention program for middle schools: Findings from the first year of implementation—Executive summary* (NCEE 2010–4008). National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Skiba, R., Reynolds, C. R., Graham, S., Sheras, P., Conoley, J. C., & Garcia-Vasquez, E. (2006). *Are zero tolerance policies effective in the schools? An evidentiary review and recommendations.* Washington, DC: American Psychological Association.

Smetana, J. (1983). Social-cognitive development: Domain distinctions and coordinations. *Developmental Review, 3*, 131–147.

Smith, J. D., Schneider, B. H., Smith, P. K., & Ananiadou, K. (2004). The effectiveness of whole-school antibullying programs: A synthesis of evaluation research. *School Psychology Review, 33*, 547–560.

Snarey, J., & Samuelson, P. (2008). Moral education in the cognitive developmental tradition: Lawrence Kohlberg's revolutionary ideas. In L. Nucci & D. Narvaez (Eds.), *Handbook of moral and character education* (pp. 53–79). New York, NY: Routledge.

Sokol, B. W., Hammond, S. I., & Berkowitz, M. V. (2010). The developmental contours of character. In T. Lovat, R. Toomey & N. Clement, (Eds.), *International research handbook on values education* (pp. 579–603). New York, NY: Springer.

Solomon, D., Watson, M., & Battistich, V. (2002). Teaching and school effects on moral/prosocial development. In V. Richardson (Ed.), *Handbook of research on teaching* (pp. 566–603). Washington, DC: American Educational Research Association.

Solomon, D., Watson, M., Battistich, V., Schaps, E., & Delucchi, K. (1996). Creating classrooms that students experience as communities. *American Journal of Community Psychology, 24*, 719–748.

Solomon, D., Watson, M., Delucchi, I., Schaps, E., & Battistich, V. (1988). Enhancing children's prosocial behavior in the classroom. *American Educational Research Journal, 25*, 527–554.

Solomon, D., Watson, M., Schaps, E., Battistich, V., & Solomon, J. (1990). Cooperative learning as part of a comprehensive classroom program designed to promote prosocial development. In D. Solomon, M. Watson, E. Schaps, V. Battistich, & J. Solomon, J. (Eds.). *Cooperative learning: Theory and research*, pp. 231–260. New York, NY: Praeger.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52*, 613–629.

Stengel, B. S., & Tom, A. R. (2006). *Moral matters: Five ways to develop the moral life of schools*. New York, NY: Teachers College Press.

Steutal, J., & Spiecker, B. (2004). Cultivating sentimental dispositions through Aristotelian habituation. *Journal of Philosophy of Education, 38*, 531–549.

Stichter, M. (2007a). Ethical expertise: The skill model of virtue. *Ethical Theory and Moral Practice, 10*(2), 183–194.

Stichter, M. (2007b). The skill model of virtue. *Philosophy in the Contemporary World, 14*(2), 39–49.

Strike, K. (1996). The moral responsibilities of educators. In J. Sikula, T. Buttery, & E. Grifton (Eds.), *Handbook of research on teacher education* (2nd ed., pp. 869–882). New York, NY: Macmillan.

Taylor, C. (1989). *Sources of the self: The making of modern identity*. Cambridge, MA: Harvard University Press.

Treisman, U. (1985). *A study of the mathematics performance of Black students at the University of California, Berkeley*. Unpublished doctoral dissertation, University of California, Berkeley, CA.

Turiel, E. (1975). The development of social concepts: Mores, customs and conventions. In J. M. Foley & D. J. DePalma (Eds.), *Moral development: Current theory and research* (pp. 7–38). Hillsdale, NJ: Erlbaum.

Turiel, E. (1977). Distinct conceptual and developmental domains: Social convention and morality. *Nebraska Symposium on Motivation, 25*, 77–116.

Turiel, E. (1983). *The development of social knowledge: Morality and convention*. Cambridge, UK: Cambridge University Press.

Valente, T. W., Ritt-Olson, A., Stacy, A., Unger, J. B., Okamoto, J., & Sussman, S. (2007). Peer acceleration: Effects of a social network tailored substance abuse prevention program among high-risk adolescents. *Addiction, 102*, 1804–1815.

Vreeman, R. C., & Carroll, A. E. (2007). A systematic review of school-based interventions to prevent bullying. *Archives of Pediatric and Adolescent Medicine, 161*, 78–88.

Walker, L. J., & Frimer, J. A. (2009). Moral personality exemplified. In D. Narvaez & D. K. Lapsley (Eds.), *Personality, identity and character: Explorations in moral psychology* (pp. 232–255). New York, NY: Cambridge University Press.

Watson, G. (1990). The primacy of character. In O. Flanagan & A. Rorty (Eds.), *Identity, character and morality* (pp. 449–470). Cambridge, MA: MIT Press.

Watson, M. (2003, with L. Ecken). *Learning to trust: Transforming difficult elementary classrooms through developmental discipline*. San Francisco, CA: Jossey-Bass.

Werch, C. E., & Owen, D. (2002). Iatrogenic effects of alcohol and drug prevention programs. *Journal of Studies on Alcohol, 63*, 581–590.

Williams, B. (1971). *Moral luck.* Cambridge, UK: Cambridge University Press.

Wilson, S. J., & Lipsey, M. W. (2007). School-based interventions for aggressive and disruptive behavior: Update of a meta-analysis. *American Journal of Preventive Medicine, 33*, 130–143.

Wynne, E. (1997). For-character education. In A. Molnar (Ed.), *The construction of children's character* (pp. 63–76). Chicago, IL: University of Chicago Press.

Wynne, E., & Ryan, K. (1997). *Reclaiming our schools: Teaching character, academics and discipline* (2nd ed.). Upper Saddle River, NJ: Merrill.

Wynne, E. & Hess, M. (1992). Trends in American youth character development: in K. Ryan & T. Lickona (Eds)., *Character development in schools and beyond* (pp. 29–48). Washington, DC: Council for Research in Values and Philosophy.

Yeager, D. S., Trzesniewski, K. H., & Dweck, C. (2011). An implicit theories intervention reduces adolescent aggression in response to victimization and exclusion. *Child Development*.

Yeager, D. S., Trzesniewski, K. H., Tirri, K., Nokelainen, P., & Dweck, C. S. (2011). Adolescents' implicit theories predict desire for vengeance after remembered and hypothetical peer conflicts: Correlational and experimental evidence. *Developmental Psychology, 47*, 1090–1107.

Yeager, D. S., & Walton, G. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research, 81*, 267–301.

Youniss, J. & Yates, M. (1997). *Community service and social responsibility*. Princeton, NJ: Princeton University Press.

Youniss, J. & Yates, M. (1999). Youth service and moral-civic identity: A case for everyday morality. *Educational Psychology Review, 11*, 361–376.

CHAPTER 8

Cooperative Learning and Achievement: Theory and Research

ROBERT E. SLAVIN

Research on cooperative learning is one of the greatest success stories in the history of educational research. Although there was some research on this topic from the early days of the past century, the amount and quality of that research greatly accelerated in the early 1970s, and continues today, more than a quarter-century later. Hundreds of studies have compared cooperative learning to various control methods on a broad range of outcome measures, but by far the most frequent objective of this research is to determine the effects of cooperative learning on student achievement. Studies of the achievement effects of cooperative learning have taken place in every major subject, at all grade levels, in all types of educational settings in many countries. Both field studies and laboratory studies have produced a great deal of knowledge about the effects of many types of cooperative interventions and about the mechanisms responsible for these effects. Further, cooperative learning is not only a subject of research and theory; it is used at some level by millions of teachers. One national survey (Puma, Jones, Rock, & Fernandez, 1993) found that 79% of elementary teachers and 62% of middle school teachers reported making some sustained use of cooperative learning. By 1998, a study by Antil, Jenkins,Wayne, and Vadasy found that 93% of teachers sampled reported using cooperative learning, with 81% reporting daily use.

Given the substantial body of research on cooperative learning (see Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003) and the widespread use of cooperative learning techniques, it might be assumed that there is little further research to be done. Yet this is not the case. There are many important unresolved research questions on this topic, and a great deal of development and evaluation is still needed. In its fullest conception, cooperative learning provides a radically different approach to instruction, whose possibilities have been tapped only on a limited basis.

There is a fair consensus among researchers about the positive effects of cooperative learning on student achievement, as well as a rapidly growing number of educators using cooperative learning in all levels of schooling and many subject areas, but there remains a great deal of confusion, even controversy, about why and how cooperative learning methods affect achievement and, most importantly, under what conditions cooperative learning has these effects. Different groups of researchers investigating cooperative learning effects on achievement begin with different assumptions and conclude by explaining the achievement effects of cooperative learning in terms that are substantially unrelated or contradictory. In earlier work, Slavin (1992, 1995, 2010) identified motivationalist, social cohesion, cognitive-developmental, and cognitive-elaboration as the four major theoretical perspectives on the achievement effects of cooperative learning.

The motivationalist perspective presumes that task motivation is the single most impactful part of the learning process, asserting that the other processes such as planning and helping are driven by individuals' motivated self-interest. Motivationalist-oriented scholars focus more on the reward or goal structure under which students operate, even going so far as to suggest that under some circumstances, interaction may not be necessary for the benefits of cooperative goal structures to manifest (Slavin, 1995). By contrast, the social cohesion perspective (also called social interdependence theory) suggests that the effects of cooperative learning are largely dependent on the cohesiveness of the group. This perspective holds that students help each other learn because they care about the group and its members and come to derive self-identity benefits from group membership (Hogg, 1987; D. Johnson & Johnson, 1999; Turner, 1987). The two cognitive perspectives focus on the interactions among groups of students, holding that these interactions lead to better learning and thus better achievement. Within the general cognitive heading, developmentalists attribute these effects to processes outlined by scholars such as Piaget and Vygotsky. Work from the cognitive elaboration perspective asserts that learners must engage in some manner of cognitive restructuring (elaboration) of new materials in order to learn them. Cooperative learning is said to facilitate that process. One reason for the continued lack of consensus among cooperative learning scholars is that each perspective tends to approach the topic without deference to the body of similar work from other perspectives and without attending to the larger picture.

This chapter offers a theoretical model of cooperative learning processes that acknowledges the contributions of work from each of the major theoretical perspectives. It places them in a model that depicts the likely role each plays in cooperative learning processes. This work further explores conditions under which each may operate, and suggests research and development needed to advance cooperative learning scholarship.

The alternative perspectives on cooperative learning may be seen as complementary, not contradictory. For example, motivational theorists would not argue that the cognitive theories are unnecessary. Instead, they assert that motivation drives cognitive process, which produces learning. They would argue that it is unlikely that over the long haul students would engage in the kind of elaborated explanations found by Webb (2008) to be essential to profiting from cooperative activity, without a goal structure designed to enhance motivation. Similarly, social cohesion theorists might hold that the utility of extrinsic incentives must lie in their contribution to group cohesiveness, caring, and prosocial norms among group members, which could affect cognitive processes.

A simple path model of cooperative learning processes, adapted from Slavin (1995), is diagrammed in Figure 8.1. It depicts the main components of a group learning interaction, and represents the functional relationships among the major theoretical approaches to cooperative learning.

This diagram of the interdependent relationships among each of the components begins with a focus on group goals or incentives based on the individual learning of all group members. That is, the model assumes that motivation to learn and to encourage and help others to learn activates cooperative behaviors that will result in learning. This would include both task motivation and motivation to interact in the group. In this model, motivation to succeed leads to learning directly, and also drives the behaviors and attitudes that lead to group cohesion, which in turn facilitates the types of group interactions; peer modeling, equilibration, and cognitive elaboration, that yield enhanced learning and academic achievement. The relationships are conceived to be reciprocal, such that as task motivation leads to the development of group cohesion, that development may reinforce and enhance task motivation. The cognitive processes may also become intrinsically rewarding and lead to increased task motivation and group cohesion.

Each aspect of the diagrammed model is well represented in the theoretical and empirical cooperative learning literature. All have well-established rationales and some supporting evidence. What follows is a review of the

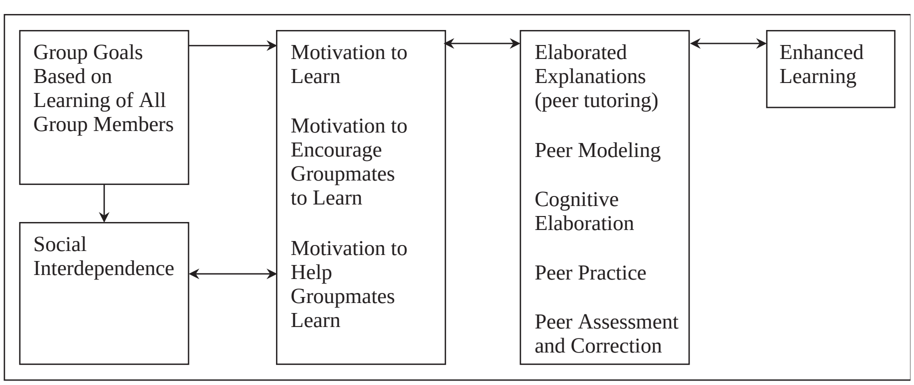


Figure 8.1 Functional relationships among the major interaction components of group learning

basic theoretical orientation of each perspective, a description of the cooperative learning mode each prescribes, and a discussion of the empirical evidence supporting each.

FOUR MAJOR THEORETICAL PERSPECTIVES ON COOPERATIVE LEARNING AND ACHIEVEMENT

There are four main theoretical perspectives on cooperative learning and achievement. These are described in the following sections.

Motivational Perspective

Motivational perspectives on cooperative learning presume that task motivation is the most important part of the process, believing that the other processes are driven by motivation. Therefore, these scholars focus primarily on the reward or goal structures under which students operate (see Slavin, 1995, 2010). From a motivationalist perspective, cooperative incentive structures create a situation in which the only way group members can attain their own personal goals is if the group is successful. Therefore, to meet their personal goals, group members must both help their groupmates to do whatever enables the group to succeed, and, perhaps even more importantly, to encourage their groupmates to exert maximum efforts. In other words, rewarding groups based on group performance (or the sum of individual performances) creates an interpersonal reward structure in which group members will give or withhold social reinforcers (e.g., praise, encouragement) in response to groupmates' task-related efforts (see Slavin, 1983a). One intervention that uses cooperative goal structures is group contingencies (see Slavin, 1987), in which group rewards are given based on group members' behaviors. The theory underlying group contingencies does not require that group members be able to actually help one another or work together. That their outcomes are dependent on one another's behavior is expected to be sufficient to motivate students to engage in behaviors that help the group to be rewarded, because the group incentive induces students to encourage goal-directed behaviors among their groupmates (Slavin, 1995, 2010).

The motivationalist critique of traditional classroom organization holds that the competitive grading and informal reward system of the classroom creates peer norms opposing academic efforts (see Coleman, 1961). One student's success decreases the chances that others will succeed, so students are likely to express norms that high achievement is for "nerds" or "teachers' pets." However, by having students work together toward a common goal, they may be motivated to express norms favoring academic achievement, to reinforce one another for academic efforts.

Not surprisingly, motivational theorists build group rewards into their cooperative learning methods. In methods developed at Johns Hopkins University (Slavin, 1994, 1995), students can earn certificates or other recognition if their average team scores on quizzes or other individual assignments exceed a preestablished criterion (see also Kagan, 1992). Methods developed by David and Roger Johnson (1999) and their colleagues at the University of Minnesota often give students grades based on group performance, which is defined in several different ways. The theoretical rationale for these group rewards is that if students value the success of the group, they will encourage and help one another to achieve.

Empirical Support for the Motivational Perspective

Considerable evidence from practical applications of cooperative learning in elementary and secondary schools supports the motivationalist position that group rewards are essential to the effectiveness of cooperative learning, with one critical qualification. Use of group goals or group rewards enhances the achievement outcomes of cooperative learning if and only if the group rewards are based on the individual learning of all group members (Slavin, 1995). Most often, this means that team scores are computed based on average scores on quizzes which all teammates take individually, without teammate help. For example, in Student Teams-Achievement Divisions, or STAD (Slavin, 1994), students work in mixed-ability teams to master material initially presented by the teacher. Following this, students take individual quizzes on the material, and the teams may earn certificates based on the degree to which team members have improved over their own past records. The only way the team can succeed is to ensure that all team members have learned, so the team members' activities focus on explaining concepts to one another, helping one another practice, and encouraging one another to achieve. In contrast, if group rewards are given based on a single group product (for example, the team completes one worksheet or solves one problem), there is little incentive for group members to explain concepts to one another, and one or two group members may do all the work (see Slavin, 1995, 2010).

In assessing the empirical evidence supporting cooperative learning strategies, the greatest weight must be given to studies of longer duration. Well executed, these are bound to be more realistically generalizable to the day-to-day functioning of classroom practices. A review of 99 studies of cooperative learning in elementary and secondary schools that involved durations of at least four weeks compared achievement gains in cooperative learning and control groups. Of 64 studies of cooperative learning methods that provided group rewards based on the sum of group members' individual learning, 50 (78%) found significantly positive effects on achievement, and none found negative effects (Slavin, 1995). The median effect size for the studies from which effect sizes could be computed was +.32 (32% of a standard deviation separated cooperative learning and control treatments). In contrast, studies of methods that used group goals based on a single group product or provided no group rewards found few positive effects, with a median effect size of only +.07. Comparisons of alternative treatments within the same studies found similar patterns; group goals based on the sum of individual learning performances were necessary to the instructional effectiveness of the cooperative learning models (e.g., Fantuzzo, Polite, & Grayson, 1990; Fantuzzo, Riggio, Connelly, & Dimeff, 1989; Huber, Bogatzki, & Winter, 1982).

Research since 1995 has continued to show positive achievement outcomes for cooperative learning methods emphasizing group goals and individual accountability (Rohrbeck et al., 2003; Webb, 2008). Rigorous evaluations in schools over periods of at least 12 weeks has shown strong impacts of cooperative learning in reading programs derived from Student Teams Achievement Divisions (STAD) in reading (Calderón, Hertz-Lazarowitz, & Slavin, 1998; Chamberlain, Daniels, Madden, & Slavin, 2007; Slavin, Daniels, & Madden, 2005), and mathematics (Barbato, 2000; Nichols, 1996). A program called Peer Assisted Learning Strategies, or PALS, has also reported positive effects on learning outcomes in reading (Calhoon, Al Otaiba, Cihak, King, & Avalos, 2007; Fuchs, Fuchs, Kazdan, & Allen, 1999; Mathes & Babyak, 2001) as well as mathematics (Fuchs, Fuchs, & Karns, 2001; Fuchs, Fuchs, Yazdian, & Powell, 2002). Similar approaches in these and other subjects have also found positive effects of cooperative approaches that emphasize group goals and individual accountability (see Slavin, 2010).

Social Cohesion Perspective

A theoretical perspective somewhat related to the motivational viewpoint holds that the effects of cooperative learning on achievement are strongly mediated by the cohesiveness of the group. The quality of the group's interactions is thought to be largely determined by group cohesion. In essence, students will engage in the task and help one another learn because they identify with the group and want one another to succeed. This perspective is similar to the motivational perspective in that it emphasizes primarily motivational rather than cognitive explanations for the instructional effectiveness of cooperative learning. However, motivational theorists hold that students help their groupmates learn primarily because it is in their own interests to do so. Social cohesion theorists, in contrast, emphasize the idea that students help their groupmates learn because they care about the group. A hallmark of the social cohesion perspective is an emphasis on teambuilding activities in preparation for cooperative learning, and processing or group self-evaluation during and after group activities. Social cohesion theorists have historically tended to downplay or reject the group incentives and individual accountability held by motivationalist researchers to be essential. They emphasize, instead, that the effects of cooperative learning on students and on student achievement depend substantially on the quality of the group's interaction (Battisch, Solomon, & Delucci, 1993). For example, Cohen (1986, pp. 69–70) states "if the task is challenging and interesting, and if students are sufficiently prepared for skills in group process, students will experience the process of groupwork itself as highly rewarding . . . never grade or evaluate students on their individual contributions to the group product." Cohen's (1994a) work, as well as that of Sharan and Sharan (1992) and Elliot Aronson and his colleagues (Aronson, Blaney, Stephan, Sikes, & Snapp, 1978) may be described as social cohesiveness theories. Cohen, Aronson, and the Sharans all use forms of cooperative learning in which students take on individual roles within the group, which Slavin (1983a) calls *task specialization* methods. In Aronson's Jigsaw method, students study material on one of four or five topics distributed among the group members. They meet in "expert groups" to share information on their topics with members of other teams who had the same topic, and then take turns presenting their topics to the team. In the Sharans' Group Investigation method, groups take on topics within a unit studied by the class as a whole, and then further subdivide the topic into tasks within the group. The students investigate the topic together and ultimately present their findings to the class as a whole. Cohen's adaptation of DeAvila and Duncan's (1980) Finding Out/Descubrimiento program has students play different roles in discovery-oriented science activities. Many cooperative learning strategies use project-based learning, along similar lines (see David, 2008; Zmuda, 2008).

One main purpose of the task specialization used in Jigsaw, Group Investigation, and Finding Out/

Descubrimiento is to create interdependence among group members. In the Johnsons' methods, a somewhat similar form of interdependence is created by having students take on roles as "checker," "recorder," "observer," and so on. The idea is that if students value their groupmates (as a result of teambuilding and other cohesiveness-building activities) and are dependent on one another, they are likely to encourage and help one another to succeed. The Johnsons' (1999) work straddles the social cohesion and motivationalist perspectives described in this paper; while their models do use group goals and individual accountability, their theoretical writings emphasize these as means to the development of social interdependence (group cohesion). Their prescriptive writings also emphasize teambuilding, group self-evaluation, and other means more characteristic of social cohesion theorists. In addition, while in most cooperative learning theory and scholarship, individual accountability is typically conceived as accountability to the teacher, social cohesion, it seems, would make individual accountability to the group highly salient since group members would have the best information about member efforts, even in the absence of explicit task accountability.

Empirical Support for the Social Cohesion Perspective

There is some evidence that the achievement effects of cooperative learning depend on social cohesion and the quality of group interactions (Ashman & Gillies, 1997; Webb & Mastergeorge, 2003). The achievement outcomes of cooperative learning methods that emphasize task specialization are less clear. Research on the original form of Jigsaw has not generally found positive effects of this method on student achievement (Slavin, 1995). One problem with this method is that students have limited exposure to material other than that which they studied themselves, so learning gains on their own topics may be offset by losses on their groupmates' topics. In contrast, there is evidence that when it is well implemented, Group Investigation can significantly increase student achievement (Sharan & Shachar, 1988). In studies of at least 4 weeks' duration, the Johnsons' (1999) methods have not been found to increase achievement more than individualistic methods unless they incorporate group rewards (in this case, group grades) based on the average of group members' individual quiz scores (see Slavin, 2010). Studies of forms of Jigsaw that have added group rewards to the original model have found positive achievement outcomes (Mattingly & Van Sickle, 1991).

Research on practical classroom applications of methods based on social cohesion theories provide inconsistent support for the proposition that building cohesiveness among students through teambuilding alone (i.e., without group incentives) will enhance student achievement. There is some evidence that group processing activities, such as teaching of helping and communication skills, can enhance the achievement effects of cooperative learning (Kutnick, Ota, & Berdondin, 2008; Mathes et al., 2003; Saleh, Lazoner, & deJon, 2007).

In general, methods that emphasize teambuilding and group process but do not provide specific group rewards based on the learning of all group members are no more effective than traditional instruction in increasing achievement (Slavin, 1995), although there is evidence that these methods can be effective if group rewards are added to them. Chapman (2001) reported on three studies, which assessed the impact of social cohesion in cooperative learning under three different incentive structures. In two of these studies students selected from their classmates those with whom they would and would not like to work. Students were then assigned to one of two types of groups. Low-cohesion groups were composed of no preferred students and some rejected students. High-cohesion groups were composed of no rejected students and some selected students. Students then studied in groups that included group goals and individual accountability, group incentives only (team recognition and small rewards), or no incentives. The researcher's hypothesis that results would vary according to group cohesion was not supported. The third of these studies is more clear. It examined high- and low-group cohesion based on task-related cohesiveness (via group processing) as opposed to social cohesiveness as the first two studies reported. This study found a marginal advantage of high task cohesion and group goals with individual accountability combined over all of the other conditions. This finding is congruent with the body of evidence concerning group cohesion and group goals and individual accountability. One major exception is Group Investigation (Sharan & Hertz-Lazarowitz, 1980; Sharan & Shachar, 1988; Y. Sharan & Sharan, 1992). However, in this method groups are evaluated based on their group products, which are composed of unique contributions made by each group member. Thus, this method may be using a form of the group goals and individual accountability held by motivationalist theories to be essential to the instructional effectiveness of cooperative learning.

Cognitive Perspectives

The major alternative to the motivationalist and social cohesiveness perspectives on cooperative learning, both of which focus primarily on group norms and interpersonal influence, is the cognitive perspective. The cognitive perspective holds that interactions among students will in themselves increase student achievement for reasons that have to do with mental processing of information rather than with motivations. Cooperative methods developed by cognitive theorists involve neither the group goals that are the cornerstone of the motivationalist methods nor the emphasis on building group cohesiveness characteristic of the social cohesion methods. However, there are several quite different cognitive perspectives, as well as some that are similar in theoretical perspective, but have developed on largely parallel tracks. The two most notable of these are described in the following sections.

Developmental Perspective

One widely researched set of cognitive theories is the developmental perspective (e.g., Damon, 1984; Murray, 1982). The fundamental assumption of the developmental perspective on cooperative learning is that interaction among children around appropriate tasks increases their mastery of critical concepts. Vygotsky (1978, p. 86) defines the zone of proximal development as "[T]he distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in *collaboration with more capable peers*" (emphasis added). In his view, collaborative activity among children promotes growth because children of similar ages are likely to be operating within one another's proximal zones of development, modeling in the collaborative group behaviors more advanced than those they could perform as individuals. Vygotsky described the influence of collaborative activity on learning as: "Functions are first formed in the collective in the form of relations among children and then become mental functions for the individual . . . . Research shows that reflection is spawned from argument."

Similarly, Piaget (1926) held that social-arbitrary knowledge—language, values, rules, morality, and symbol systems—can only be learned in interactions with others. Peer interaction is also important in logical-mathematical thought in disequilibrating the child's egocentric conceptualizations and in providing feedback to the child about the validity of logical constructions.

There is a great deal of empirical support for the idea that peer interaction can help nonconservers become conservers. For example, some young children think that a sandwich cut into four pieces is "more sandwich." Such children ("nonconservers") have not mastered the conservation principle, while those who understand that cutting up a sandwich does not change the amount of sandwich are called *conservers* (Berk, 2009; Feldman, 2010). Many studies have shown that when conservers and nonconservers of about the same age work collaboratively on tasks requiring conservation, the nonconservers generally develop and maintain conservation concepts (see Bell, Grossen, & Perret-Clermont, 1985; Murray, 1982; Perret-Clermont, 1980). In fact, a few studies (e.g., Ames & Murray, 1982; Mugny & Doise, 1978) have found that pairs of disagreeing nonconservers who had to come to consensus on conservation problems both gained in conservation. The importance of peers' operating in one another's proximal zones of development was demonstrated by Kuhn (1972), who found that a small difference in cognitive level between a child and a social model was more conducive to cognitive growth than a larger difference.

On the basis of these and other findings, many Piagetians (e.g., Damon, 1984; Murray, 1982; Wadsworth, 1984) have called for an increased use of cooperative activities in schools. They argue that interaction among students on learning tasks will lead to improved student achievement. Students will learn from one another because in their discussions of the content, cognitive conflicts will arise, inadequate reasoning will be exposed, disequilibration will occur, and higher-quality understandings will emerge.

From the developmental perspective, the effects of cooperative learning on student achievement would be largely or entirely due to the use of cooperative tasks. Damon (1984, p. 337) explicitly rejects the use of "extrinsic incentives as part of the group learning situation," arguing that "there is no compelling reason to believe that such inducements are an important ingredient in peer learning." In this view, opportunities for students to discuss, to argue, and to present and hear one another's viewpoints are the critical element of cooperative learning with respect to student achievement.

For example, Damon (1984, p. 335) integrates Piagetian, Vygotskian, and Sullivanian perspectives on peer collaboration to propose a "conceptual foundation for a peer-based plan of education":

- Through mutual feedback and debate, peers motivate one another to abandon misconceptions and search for better solutions.
- The experience of peer communication can help a child master social processes, such as participation and argumentation, and cognitive processes, such as verification and criticism.

- Collaboration between peers can provide a forum for discovery learning and can encourage creative thinking.
- Peer interaction can introduce children to the process of generating ideas.

One category of practical cooperative methods closely related to the developmental perspective is group discovery methods in mathematics, such as Marilyn Burns' (1981) Groups of Four method. In these techniques, students work in small groups to solve complex problems with relatively little teacher guidance. They are expected to discover mathematical principles by working with unit blocks, manipulatives, diagrams, and other concrete aids. The theory underlying the presumed contribution of the group format is that in the exploration of opposing perceptions and ideas, higher-order understandings will emerge; also, students operating within one another's proximal zones of development will model higher-quality solutions for one another.

Empirical Evidence for the Developmental Perspective

Despite considerable support from theoretical and laboratory research, there is little evidence, from classroom experiments conducted over meaningful time periods, that "pure" cooperative methods, which depend solely on interaction, do produce higher achievement. However, it is likely that the cognitive processes described by developmental theorists are important mediating variables, which can help explain the positive outcomes of effective cooperative learning methods (Rohrbeck et al., 2003; Slavin, 1995, 2010; Webb, 2008).

Cognitive Elaboration Perspective

A cognitive perspective on cooperative learning quite different from the developmental viewpoint might be called the *cognitive elaboration perspective*. Research in cognitive psychology has long held that if information is to be retained in memory and related to information already in memory, the learner must engage in some sort of cognitive restructuring, or elaboration, of the material (Wittrock, 1986). One of the most effective means of elaboration is explaining the material to someone else. Research on peer tutoring has long found achievement benefits for the tutor as well as the tutee (Devin-Sheehan, Feldman, & Allen, 1976). In this method, students take roles as recaller and listener. They read a section of text, and then the recaller summarizes the information while the listener corrects any errors, fills in any omitted material, and helps think of ways both students can remember the main ideas. The students switch roles on the next section.

One practical use of the cognitive elaboration potential of cooperative learning is in writing process models (Harris, Graham, & Mason, 2006), in which students work in peer response groups or form partnerships to help one another draft, revise, and edit compositions. Such models have been found to be effective in improving creative writing (Graham, 2006), and a writing process model emphasizing use of peer response groups is part of the Cooperative Integrated Reading and Composition Writing/Language Arts program (Stevens, Madden, Slavin, & Farnish, 1987), a program that has also been used to increase student writing achievement. Part of the theory behind the use of peer response groups is that if students learn to evaluate others' writing, they will become better writers themselves, a variant of the cognitive elaboration explanation. However, it is unclear at present how much of the effectiveness of writing process models can be ascribed to the use of cooperative peer response groups as opposed to other elements (such as the revision process itself).

Another teaching model based on the cognitive elaboration perspective on cooperative learning is Reciprocal Teaching (Palincsar & Brown, 1984), a method for teaching reading comprehension skills. In this technique, students are taught to formulate questions for one another around narrative or expository texts. In doing so, they must process the material themselves and learn how to focus in on the essential elements of the reading passages.

Empirical Evidence for the Cognitive Elaboration Perspective

Donald Dansereau and his colleagues at Texas Christian University have found in a series of brief studies that college students working on structured "cooperative scripts" can learn technical material or procedures far better than can students working alone (Dansereau, 1988; Newbern, Dansereau, Patterson, & Wallace, 1994; O'Donnell, 1996; O'Donnell & Dansereau, 1992). Dansereau and his colleagues found in a series of studies that while both the recaller and the listener learned more than did students working alone, the recaller learned more (O'Donnell & Dansereau, 1992). This mirrors both the peer tutoring findings and the findings of Noreen Webb (1989, 1992), who discovered that the students who gained the most from cooperative activities were those who provided elaborated explanations to others. In this research as well as in Dansereau's, students who received elaborated explanations learned more than those who worked alone, but not as much as those who served as explainers. Studies of Reciprocal Teaching have generally supported its positive effects on student achievement (O'Donnell, 2000;

Palincsar, 1987; Rosenshine & Meister, 1994). However, studies of group discovery methods such as Groups of Four (Burns, 1981) find few achievement benefits for students in comparison to traditional expository teaching (Davidson, 1985; L. Johnson, 1985; L. Johnson & Waxman, 1985).

What Factors Contribute to Achievement Effects of Cooperative Learning?

Although the four perspectives being discussed can rightfully be considered complementary as they relate functionally to cooperative learning, there are real philosophical differences that underlie the differing conceptions on how best to proceed. They differ in large part in where they locate motivation for learning behaviors. There is particular disagreement among researchers who emphasize the changes in incentive structure brought about by certain forms of cooperative learning, and those who hold that changes in task structure are all that is required to enhance learning. The difficulty in settling these differences lies in the fact that research in each of the four traditions tends to establish settings and conditions favorable to that perspective. For example, most research on cooperative learning models from the motivational and social cohesiveness perspectives takes place in real classrooms over extended periods, as both extrinsic motivation and social cohesion may be assumed to take time to show their effects. In contrast, studies undertaken from the developmental and cognitive elaboration perspectives tend to be short, making issues of motivation moot. These latter paradigms also tend to use pairs, rather than groups of four. Pairs involve a much simpler social process than groups of four, which may need time to develop ways of working well together. Developmental research almost exclusively uses young children trying to master conservation tasks, which bear little resemblance to the "social-arbitrary" learning that characterizes most school subjects; cognitive elaboration research mostly involves college students. Disentangling the effects is further complicated by the fact that empirical investigation and classroom applications of cooperative learning typically change aspects of both incentive and task structures, making it difficult to determine which factors are responsible for which outcomes.

Nonetheless, research on cooperative learning has moved beyond the question of whether cooperative learning is effective in accelerating student achievement to focus on the conditions under which it is optimally effective. The preceding discussion has described alternative overarching theories to explain cooperative learning effects, and an impressive set of empirical findings associated with each. It is useful to examine the empirical cooperative learning research across the boundaries of theoretical perspective in order to determine which factors consistently contribute to or detract from the effectiveness of cooperative learning.

There are two primary ways to learn about factors that contribute to the effectiveness of cooperative learning. One is to compare the outcomes of studies of alternative methods. For example, if programs that incorporated group rewards produced stronger or more consistent positive effects (in comparison to control groups) than programs that did not, then this would provide one kind of evidence that group rewards enhance the outcomes of cooperative learning. The problem with such comparisons is that the studies being compared usually differ in measures, durations, subjects, and many other factors that could explain differing outcomes. Better evidence is provided by studies that compared alternative forms of cooperative learning in a single or series of investigations, such as the important series of studies reported by Elaine Chapman (2001). In these 10 studies, conducted in Australian schools, Chapman and her colleagues set out to examine systematically and under a common methodological framework several of the major mediating factors that have been identified in cooperative learning research and practice. In such studies, most factors other than the ones being studied can be held constant. The following sections discuss both types of studies to further explore factors that contribute to the effectiveness of cooperative learning for increasing achievement.

Structuring Group Interactions

There is some evidence that carefully structuring the interactions among students in cooperative groups can be effective, even in the absence of group rewards. For example, Meloth and Deering (1992) compared students working in two cooperative conditions. In one, students were taught specific reading comprehension strategies and given "think sheets" to remind them to use these strategies (e.g., prediction, summarization, character mapping). In the other group, students earned team scores if their members improved each week on quizzes. A comparison of the two groups on a reading comprehension test found greater gains for the strategy group (also see Meloth & Deering, 1994), Berg (1993) and Newbern et al. (1994) found positive effects of scripted dyadic methods that did not use group rewards, and Van Oudenhoven, Wiersma, and Van Yperen (1987) found positive effects of structured pair learning whether feedback was given to the pairs or only to individuals. Ashman and Gillies (1997) found better performance among students trained in specific cooperative learning skills and strategies than among untrained students. They also found that children trained in cooperative learning skills were consistently more helpful and inclusive of their peers and that the differences were maintained over the 12 weeks of the study. Webb and Farivar (1994) also found better achievement and helping behaviors among Latino and African-American but not White or Asian students who received training in academic helping skills.

Research on Reciprocal Teaching (Palincsar & Brown, 1984) also shows how direct strategy instruction can enhance the effects of a technique related to cooperative learning. In this method, the teacher works with small groups of students and models such cognitive strategies as question generation and summarization. The teacher then gradually turns over responsibility to the students to carry on these activities with each other. Studies of Reciprocal Teaching have generally found positive effects of this method on reading comprehension (Palincsar & Brown, 1984; Palincsar, Brown, & Martin, 1987; Rosenshine & Meister, 1994). Chapman (2001) compared structured group interaction (resource interdependence) to individual learning and to structured group interaction with group interdependent reward. She reported that structuring group interactions was superior to individual learning and that the addition of group goals and individual accountability did not further enhance these effects. Such findings make it clear that the effects of group rewards based on the individual efforts of all group members learning in cooperative learning are largely indirect. They serve to motivate students to engage in the types of behaviors, such as providing groupmates with elaborated explanations that enhance learning outcomes. The research by Meloth and Deering (1992, 1994), Berg (1993), and others suggests that students can be directly taught to engage in cognitive and interpersonal behaviors that lead to higher achievement, without the need for group rewards.

However, there is also evidence to suggest that a combination of group rewards and strategy training produces much better outcomes than either alone. The Fantuzzo, King, and Heller (1992) study directly made a comparison between rewards alone, strategy alone, and a combination, and found the combination to be by far the most effective. Further, the outcomes of dyadic learning methods, which use group rewards as well as strategy instruction, produced some of the largest positive effects of any cooperative methods, much larger than those found in the Berg (1993) study that provided groups with structure but not rewards. As noted earlier, studies of scripted dyads also find that adding incentives adds to the effects of these strategies (O'Donnell, 1996). The consistent positive findings for Cooperative Integrated Reading and Composition (CIRC) (Stevens et al., 1987), which uses both group rewards and strategy instruction, also argue for this combination (see Slavin & Lake, 2008).

Group Goals and Individual Accountability

As noted earlier, several reviews of the cooperative learning literature have concluded that cooperative learning is most consistently effective when groups are recognized or rewarded based on individual learning of their members (Davidson, 1985; Ellis & Fouts, 1993; Manning & Lucking, 1991; Mergendoller & Packer, 1989; Newmann & Thompson, 1987; Slavin, 1995, 2010). The specific form of group goals implemented ranges from simple recognition to classroom privileges to material rewards, such as certificates. Individual accountability may be achieved by averaging students' individual quiz scores to derive the group score or by using the performance of a randomly selected individual to represent the group. In contrast, methods lacking group goals give students only individual grades or other individual feedback, with no group consequence for doing well as a group. Methods lacking individual accountability might reward groups for doing well, but the basis for this reward would be a single project, worksheet, quiz, or other product that could theoretically have been done by only one group member.

If we presume that students act solely out of self-interest, the importance of group goals and individual accountability is in providing students with an incentive to help each other and to encourage each other to put forth maximum effort (Slavin, 1995). If students can only do as well as the group and the group can succeed only by ensuring that all group members have learned the material, then group members will be motivated to teach each other. Studies of behaviors within groups that relate most to achievement gains consistently show that students who give each other explanations (and less consistently, those who receive such explanations) are the students who learn the most in cooperative learning. Giving or receiving answers without explanation has generally been found to reduce achievement (Webb, 1989, 1992, 2008). At least in theory, group goals and individual accountability should motivate students to engage in the behaviors that increase achievement and avoid those that reduce it. If a group member wants her group to be successful, she must teach her groupmates (and learn the material herself). If she simply tells her groupmates the answers, they will fail the quiz that they must take individually. If she ignores a groupmate who does not understand the material, the groupmate will fail and the group will fail as well. In groups lacking individual accountability, one or two students may do the group's work, while others engage in "free riding" or "social loafing" (Latane, Williams, & Harkins, 1979; Williams & Karau, 1991). For example, in a group asked to complete a single project or solve a single problem, some students may be discouraged from participating. A group trying to complete a common problem may not want to stop and explain what is going on to a groupmate who does not understand, or may feel it is useless or counterproductive to try to involve certain groupmates.

The importance of group goals that can be achieved only by ensuring the learning of all group members is supported by empirical evidence that emphasizes both degree and consistency. Recall that 25 studies of methods that incorporated group goals and individual accountability produced a much higher median effect size (ES +.32) than did studies of other methods (ES +.07). Recall also that 78% of studies assessing the effectiveness of methods using group goals and individual accountability found significantly positive effects, and that there were no significantly negative effects. This is compared to only 37% significantly positive effects and 14% significantly negative effects in studies of methods lacking group goals and individual accountability.

A comparison among Learning Together studies (D. Johnson & Johnson, 1989) supports the same conclusions. Across eight studies of Learning Together methods in which students were rewarded based on a single worksheet or product, the median effect size was near zero (ES = +.04). However, among four studies that evaluated forms of the program in which students were graded based on the average performance of all group members on individual assessments, three found significantly positive effects.

Finally, comparisons within the same studies consistently support the importance of group goals and individual accountability. For example, Chapman (2001) reported on five studies that compared group goals and individual accountability to other incentive formats. In two of those, cooperative learning with group goals and individual accountability resulted in better performance than individualized incentives on a math task. Two more of the studies found similar results using a reading task. In the fifth study, mentioned earlier, resource interdependence with and without group interdependent incentives yielded similar performance. That is, students who simply shared materials performed similarly to others who shared materials and were assigned interdependent goals. It is also noteworthy that an additional study by the same researchers compared group goals and individual accountability with and without cooperative interaction and found that the combination of group goals and individual accountability and cooperative interaction was superior to incentive alone. In four of the five comparisons made by Chapman and her associates, cooperative learning with group goals and individual accountability resulted in superior student performance in comparison to cooperation without such elements.

Fantuzzo et al. (1992) conducted a component analysis of Reciprocal Peer Tutoring (RPT). They compared four conditions in which students worked in dyads to learn math. In one, students were rewarded with opportunities to engage in special activities of their choice if the sum of the dyad's scores on daily quizzes exceeded a set criterion. In another, students were taught a structured method of tutoring each other, correcting efforts, and alternating tutor-tutee roles. A third condition involved a combination of rewards and structure, and a fourth was a control condition in which students worked in pairs but were given neither rewards nor structure. The results showed that the reward + structure condition had by far the largest effects on math achievement (ES = +1.42), and that reward alone had much larger effects than structure alone. The reward + structure condition exceeded structure-only by an effect size of +1.88, and the reward-only group exceeded control by an effect size of +.21 (the structure-only group performed less well than the control group).

Other studies also found greater achievement for cooperative methods using group goals and individual accountability than for those that do not. Huber, Bogatzki, and Winter (1982) compared a form of Student Team Achievement Divisions (STAD) to traditional group work lacking group goals and individual accountability. The STAD group scored significantly better on a math test (ES = +.23). In a study of Team Assisted Individualization (TAI), Cavanagh (1984) found that students who received group recognition based on the number of units accurately completed by all group members both learned more (ES = +.24) and completed more units (ES = +.25) than did students who received individual recognition only. O'Donnell (1996) compared dyads working with and without incentives. Students who received explicit incentives based on their learning learned significantly more than those who did not, in three experimental studies. Okebukola (1985), studying science in Nigeria, found substantially greater achievement in STAD and Teams Games Tournaments (TGT), methods using group goals and individual accountability, than in forms of Jigsaw and Johnsons' methods that did not. In another study, Okebukola (1986) found much higher achievement in classes that used a method combining cooperation and group competition (one form of group reward) than in a "pure" cooperative method that did not use group rewards of any kind (ES $= +1.28$).

Are There Alternatives to Group Goals and Individual Accountability?

Many educators express discomfort with using group goals and individual accountability to manipulate motivation to achieve. Teachers often complain of the record keeping involved, some voice philosophical objections to the idea of using extrinsic rewards to motivate learning. Such concerns raise the question of whether group goals and individual accountability are always necessary, and indeed, whether such goal structures are detrimental to continued learning.

Before exploring this question, it is important to make clear the theoretical rationale for the importance of group goals and individual accountability. This combination is principally designed to motivate students not only to work together, but to be concerned about the learning of their groupmates. The assumption is that while groupmates may readily interact with and help each other, without appropriate structuring, this interaction and help may take the form of sharing answers or doing each other's work, rather than making certain that groupmates understand the material and can independently solve problems. In cooperative learning techniques in which groups are rewarded based on the individual learning of each member, the group members want to succeed. The only way they can make this happen is to teach and assess one another and to make certain that every group member can independently show mastery of whatever the group is studying.

Those opposed to using group goals and individual accountability in cooperative learning warn of possible costs of using rewards in classrooms. A few reviewers (e.g., Damon, 1984; Kohn, 1986) have recommended against the use of group rewards, fearing that they may undermine long-term motivation. There is little empirical evidence of undermining effects resulting from the use group goals and individual accountability. Chapman (2001), noting that it would be "difficult to justify the use of a procedure that impacted positively on student achievement but negatively on their affective response to the subject matter" (p. 3), measured students' affective reactions to the lesson content and subject matter used in 10 studies that compared group goals and individual accountability to other incentive structures and found no evidence that the use of group goals and individual accountability had negative effects on student self reports of subject-related attitudes. In some cases, students' attitudes were significantly more positive. This goal structure certainly does not undermine long-term achievement. Among multiyear studies, methods that incorporate group rewards based on individual learning performance have consistently shown continued or enhanced achievement gains over time (Calderón et al., 1998; Greenwood, Delquadri, & Hall, 1989; Stevens & Slavin, 1995a, 1995b). In contrast, multiyear studies of methods lacking group rewards found few achievement effects in the short or long-term (Solomon, Watson, Schaps, Battistich, & Solomon, 1990; Talmage, Pascarella, & Ford, 1984). The rationale that assumes there is a cost to be incurred for using group goals and individual accountability is not well articulated in the literature, but seems to be derived from the ongoing debate over the relationship between reinforcement, reward, and students' intrinsic motivation. A 1994 meta-analysis (Cameron & Pierce, 1994), which supported earlier assertions that overall, reward does not decrease students' intrinsic motivation, sparked considerable debate (Cameron & Pierce, 1996; Deci, Koestner, & Ryan, 1999; Lepper, Henderlong, & Gingras, 1999; Lepper, Keavney, & Drake, 1996). However, insofar as the use of the specific goal structure that combines group goals and individual accountability is concerned, there is little empirical evidence of these undermining effects. Moreover, the pervasive use of extrinsic incentives in elementary and secondary schools with or without cooperative learning makes the question largely moot. A more pertinent question is whether extrinsic incentives should be given at the group *and* individual level or only at the individual level (as is current practice in virtually all classrooms in existence). It remains incumbent upon theorists who oppose these methods to develop and demonstrate consistent, substantial, and enduring achievement benefits of cooperative learning or other learning models that do not use this goal structure. For now, the preponderance of evidence indicates that the combination of cooperative learning strategies with group goals and individual accountability is a practical, feasible, and effective method of enhancing students' academic achievement.

There do appear to be, however, a few instances in which this structure of group goals and individual accountability may not be necessary. These are cases in which achievement gains, in comparison to control groups, have been found for cooperative learning treatments that lack group goals, individual accountability, or both of these elements. Although theoretical and empirical support for the centrality of group goals and individual accountability is strong for a broad range of school tasks, the following paragraphs summarize the evidence that some kinds of learning may not require these elements. These include higher-level cognitive tasks, controversial tasks without single answers, voluntary study groups, and structured dyadic tasks.

Higher-Level Cognitive Tasks

Cohen (1994b) raises the possibility that while group rewards and individual accountability may be necessary for lower-level skills, they may not be for higher-level ones. As evidence of this, she cites a study by Sharan et al. (1984) that compared STAD and Group Investigation. In this study STAD and GI students performed equally well (and better than controls) on a test of English as a foreign language, and STAD students did significantly better than GI on “lower level” (knowledge) items (ES = +.38). On “high level” items, GI students performed nonsignificantly higher than STAD students, with a difference of less than half of a point on a 15-point test. Otherwise there is no evidence that group rewards are less important for higher-order skills, although the possibility is intriguing.

Controversial Tasks Without Single Answers

One category of tasks that may not require group goals and individual accountability is tasks in which it is likely that students will benefit by hearing others thinking aloud—the classic Vygotskian paradigm. Students in collaborating groups make overt their private speech, giving peers operating at a slightly lower cognitive level on a given task a stepping stone to understanding and incorporating higher-quality solutions in their own private speech (see Bershon, 1992). Tasks of this kind would be ones at a very high level of cognitive complexity but without a well-defined path to a solution or a single correct answer, especially tasks on which there are likely to be differences of opinion. For such tasks, the process of participating in arguments or even of listening to others argue and justify their opinions or solutions may be enough to enhance learning, even without in-group teaching, explanation, or assessment. Perhaps the best classroom evidence on this type of task is from D. Johnson and R. Johnson’s (1979) studies of structured controversy, in which students argue both sides of a controversial issue using a structured method of argumentation. Other examples of such tasks might include group projects without a single right answer (e.g., planning a city), and solving complex problems, such as nonroutine problems in mathematics, or finding the main idea of paragraphs. In each of these cases, it may be that hearing the thinking processes of others is beneficial even in the absence of co-teaching.

At the same time, it is still important to note that the use of group goals and individual accountability is unlikely to interfere with modeling of higher-level thinking, and is likely to add teaching and elaborated explanation (Webb, 2008). For example, Stevens, Slavin, and Farnish (1991) evaluated a method of teaching students to find the main ideas of paragraphs in which four-member groups first came to consensus on a set of paragraphs and then worked to make certain that every group member could find the main idea. Groups received certificates based on the performance of their members on individual quizzes. The consensus procedure evokes arguments and explanations, modeling higher quality thinking, but the teaching procedure makes sure that students can each apply their new understandings.

Voluntary Study Groups

A second category of cooperative tasks that may not require group goals and individual accountability is situations in which students are strongly motivated to perform well on an external assessment and can clearly see the benefit of working together. The classic instance of this is voluntary study groups common in postsecondary education, especially in medical and law schools. Medical and law students must master an enormous common body of information, and it is obvious to many students that participating in a study group will be beneficial. Although there is little extrinsic reason for students to be concerned about the success of other study group members, there is typically a norm within study groups that each member must do a good job of presenting to the group. Because study group membership is typically voluntary, study group members who do not participate effectively may be concerned about being invited back the next term.

There is little research on voluntary study groups in postsecondary institutions, and it is unclear how well this idea would apply at the elementary or secondary levels. In the United States, it would seem that only college-bound senior high school students are likely to care enough about their grades to actively participate in study groups like those seen at the postsecondary level, yet it may be that similar structures could be set up by teachers and that norms of reciprocal responsibility to the group could be developed. Another problem, however, is that voluntary study groups can and do reject (or fail to select) members who are felt to have little to contribute to the group. This could not be allowed to happen in study groups sponsored by the school.

Structured Dyadic Tasks

A third category of cooperative tasks that may not require group goals and individual accountability is tasks that are so structured that learning is likely to result if students engage in them, regardless of their motivation to help their partners learn. Examples of this were discussed earlier. One is the series of studies by Dansereau (1988) and his colleagues in which pairs of college students proceeded through a structured sequence of activities to help each other learn complex technical information or procedures (see O'Donnell & Dansereau, 1992). Another is two Dutch studies of spelling, which also involved dyads, and in which the study behavior (quizzing each other in turn) was structured and obviously beneficial (Van Oudenhoven, Van Berkum, & Swen-Koopmans, 1987; Van Oudenhoven, Wiersma, & Van Yperen, 1987). In contrast to cooperative methods using group goals and individual accountability to indirectly motivate students to teach each other, these methods allow the teacher to directly motivate students to engage in structured turn taking behaviors known to increase learning. The successful use of structured dyadic tasks in elementary schools seems largely limited to lower level, rote skills such as memorizing multiplication tables, spelling lists, or place names.

As in the case of controversial tasks without single correct answers, there is evidence that adding group rewards to structured dyadic tasks enhances the effects of these strategies. Fantuzzo et al. (1990) evaluated a dyadic study strategy called Reciprocal Peer Tutoring. A simple pair study format did not increase student arithmetic achievement, but when successful dyads were awarded stickers and classroom privileges, their achievement markedly increased. A similar comparison of dyadic tutoring with and without group rewards at the college level also found that group rewards greatly enhanced the achievement effects of a structured dyadic study model (Fantuzzo et al., 1989), and a series of studies have shown positive effects of the Reciprocal Peer Tutoring model in many subjects and at many grade levels (e.g., Fantuzzo et al., 1990; Van Keer & Verhaeghe, 2005, 2008). A similar program combining structured reciprocal tutoring with group rewards called Classwide Peer Tutoring has also been successful in increasing student achievement in a variety of subjects and grade levels (Greenwood et al., 1989; Maheady, Harper, & Mallette, 1991), and a similar approach called Peer Assisted Learning Strategies, or PALS, has been successfully evaluated in several subjects and grade levels (Calhoon et al., 2007; Mathes et al., 2003).

Reconciling the Four Perspectives

The process model discussed above shows how group goals might operate to enhance the learning outcomes of cooperative learning. Provision of group goals based on the individual learning of all group members might affect cognitive processes directly, by motivating students to engage in peer modeling, cognitive elaboration, and/or practice with one another. Group goals may also lead to group cohesiveness, increasing caring and concern among group members and making them feel responsible for one another's achievement, thereby motivating students to engage in cognitive processes that enhance learning. Finally, group goals may motivate students to take responsibility for one another independently of the teacher, thereby solving important classroom organization problems and providing increased opportunities for cognitively appropriate learning activities. Scholars whose theoretical orientations de-emphasize the utility of extrinsic rewards attempt to intervene directly on mechanisms identified as mediating variables in the model described earlier. For example, social cohesion theorists intervene directly on group cohesiveness by engaging in elaborate teambuilding and group processing training. The Sharan and Shachar (1988) Group Investigation study suggests that this can be successfully done, but it takes a great deal of time and effort. In this study, teachers were trained over the course of a full year, and then teachers and students used cooperative learning for three months before the study began. Earlier research on Group Investigation failed to provide a comparable level of preparation of teachers and students, and the achievement results of these studies were less consistently positive (Sharan et al., 1984).

Cognitive theorists would hold that the cognitive processes that are essential to any theory relating cooperative learning to achievement can be created directly, without the motivational or affective changes discussed by the motivationalist and social cohesion theorists. This may turn out to be accurate. For example, research on Reciprocal Teaching in reading comprehension (Palincsar & Brown, 1984; Rosenshine & Meister, 1994) shows promise as a means of intervening directly in peer cognitive processes. Reciprocal teaching strategies can be effective in a variety of subject areas, with students of various ages and in both controlled experiments and classroom practice (Alfassi, 1998; Carter, 1997; Hart & Speece, 1998; King & Johnson-Parent, 1999; Lederer, 2000).

Long-term applications of Dansereau's (1988) cooperative scripts for comprehension of technical material and procedural instructions also seem likely to be successful.

From the perspective of the model diagrammed in Figure 8.1, starting with group goals and individual accountability permits students in cooperative learning groups to benefit from the full range of factors that are known to affect cooperative learning outcomes. Group goals and individual accountability may not always be absolutely necessary, but to ignore them would be to ignore the tool with the most consistent evidence of positive effects on student achievement.

Which Students Gain Most From Cooperative Learning? Important Subpopulations

Several studies have focused on the question of which students gain the most from cooperative learning. One particularly important question relates to whether cooperative learning is beneficial to students at all levels of prior achievement. It would be possible to argue (see, for example, Allen, 1991; Robinson, 1990) that high achievers could be held back by having to explain material to their low-achieving groupmates. However, it would be equally possible to argue that because students who give elaborated explanations typically learn more than those who receive them (Webb, 2008), high achievers should be the students who benefit most from cooperative learning because they give the most frequent elaborated explanations.

The evidence from experimental studies that met the inclusion criteria for this review support neither position. A few studies found better outcomes for high achievers than for low, and a few found that low achievers gained the most. Most, however, found equal benefits for high, average, and low achievers in comparison to their counterparts in control groups. One two-year study of schools using cooperative learning most of their instructional day found that high, average, and low achievers all achieved better than controls at similar achievement levels (see Slavin, 1995). However, a separate analysis of the very highest achievers, those in the top 10% and top 5% of their classes at pretest, found particularly large positive effects of cooperative learning on these students (Slavin, 1991; Stevens & Slavin, 1995b).

A number of studies have looked for possible differences in the effects of cooperative learning on students of different ethnicities. As mentioned earlier, several have found different, often more pronounced effects for African-American students (Albury, 1993; Boykin, 1994; Coleman, 1998; Garibaldi, 1979; Haynes & Gebreyesus, 1992; Hurley, 1999; D. Johnson & Johnson, 1985; Jordan, 1992; Slavin, 1983b; Slavin & Oickle, 1981; Tharp & Gallimore, 1988). However, other studies have found equal effects of cooperative learning for students of different backgrounds (see Slavin, 1995, 2010). These differing findings are likely due to differences in experimental methodologies and to differences in the forms of cooperation employed in the research. The second of these distinctions may be particularly important to educational practice. Since African-American and other minority students are over-represented among underachievers (National Center for Education Statistics [NCES], 2000), it will be important to understand how students' backgrounds may mediate the effects of particular cooperative learning strategies. The communalism studies mentioned earlier and a few others have begun to explore these issues and the evidence to date is encouraging. Despite some significant variation in methodology and in empirical findings, cooperative techniques have proven to have generally positive effects for African-American, European-American (Hurley, 1999; Slavin, 1985), Israeli (Rich, Amir, & Slavin, 1986), Hispanic (Calderón et al., 1998), Nigerian (Okebukola, 1986) and other cultural and ethnic groups. Still, much additional information will be needed to ensure that cooperative learning practices are implemented in ways that meet the needs of the children being served.

Other studies have examined a variety of factors that might interact with achievement gain in cooperative learning. Okebukola (1986) and Wheeler and Ryan (1973) found that students who preferred cooperative learning learned more in cooperative methods than those who preferred competition. Chambers and Abrami (1991) found that students on successful teams learned more than those on less successful teams.

Finally, a small number of studies have compared variations in cooperative procedures. Moody and Gifford (1990) found that while there was no difference in achievement gains, homogeneous groups performed better than mixed groups. Foyle, Lyman, Tompkins, Perne, and Foyle (1993) found that cooperative learning classes assigned daily homework achieved more than those not assigned homework. Kaminski (1991) and Rich et al. (1986) found that explicit teaching of collaborative skills had no effect on student achievement. Hurley (1999) found that African-American students performed best in cooperative learning groups with shared goals, while European-American students performed best in cooperative learning groups with explicit individual accountability. Jones (1990) compared cooperative learning using group competition to an otherwise identical method that compared groups to a set standard (as in STAD). There were no achievement differences, but a few attitude differences favored the group competition.

Outcomes Other Than Achievement

Another important justification for the widespread use of cooperative learning techniques in education is that they have been associated with a host of affective, nonachievement effects. These include increased willingness to take on difficult tasks; intrinsic motivation; long-term retention; higher-order thinking; metacognition; creative problem solving; ability to generalize concepts across content areas; positive attitudes toward schooling and curriculum content; time on task; on-task verbalization; more positive cross-group relations (ethnicity, ability); fewer disruptions; and better psychological health, self-esteem, and emotional intelligence (Albury, 1993; Boykin & Ellison, 1995; Cooper & Slavin, 2004; D. Johnson & Johnson, 1983; Leikin & Zaslavsky, 1997; Nelson, Johnson, & Marchand-Martella, 1996; Parillo, 2008; Slavin, 1995; Yost & Tucker, 2000; Zahn, Kagan, & Wideman, 1986; also see D. Johnson & Johnson, 1999, for a detailed discussion of nonachievement benefits of cooperative learning). Thus, aside from the compelling, if somewhat pragmatic goal of enhancing simple academic achievement, cooperative learning techniques have shown enormous potential to facilitate children's psychological health and development while preparing them for the intellectual demands of an information-dependent society.

Directions for Additional Research

The four theoretical perspectives explaining the achievement effects of cooperative learning described in this paper are all useful in expanding our understanding of the conditions under which various forms of cooperative learning may affect student achievement. Figure 8.1, which links these theoretical perspectives in a causal model, provides a framework for predicting different causal paths by which cooperative learning might affect achievement.

In particular, the model shows the importance of group goals and individual accountability, but also suggests ways that achievement might be affected more directly by introducing peer activities that may not require extrinsic motivation. This paper explores three types of tasks or situations in which group goals and individual accountability may not be necessary: controversial tasks lacking single right answers, voluntary study groups, and structured dyadic tasks. There is little research on voluntary study groups (such as medical or law school study groups), but research does find instances in which certain types of cooperative tasks are effective without group goals and individual accountability. However, there is also evidence that adding group goals and individual accountability to these tasks further enhances their instructional effectiveness.

Clearly, there is a need for further research on conditions under which group goals and individual accountability may not be necessary. As a practical matter, it is probably the case that most teachers using cooperative learning do not provide group rewards based on the individual learning of all group members, and feel that it is unnecessary and cumbersome to do so. Widespread reluctance to use extrinsic incentives, based in part on a misreading of research on the "undermining" effects of rewards on long-term motivation (Cameron & Pierce, 1994), has contributed to many educators' reluctance to use group rewards. For both theoretical and practical reasons it would be important to know how to make "reward-free" cooperative learning methods effective.

A related need for research concerns effective uses of project-based learning. Most research on cooperative learning has involved the use of cooperative methods to help children master fairly well-defined skills or information. The key exceptions to this are work of the Sharans (Y. Sharan & Sharan, 1992) and of Elizabeth Cohen (1994b). Cooperative learning practice has increasingly shifted toward project-based or active learning (Zmuda, 2008), in which students work together to produce reports, projects, experiments, and so on. It is possible to make inferences to optimal conditions for project-based learning from research on more cut-and-dried content (see Slavin, 1996), and the work of Cohen and the Sharans does imply that well-implemented, project-based learning can be more effective than traditional instruction (the Sharan and Shachar [1988] study is by far the best evidence of this). However, there is a great deal of work yet to be done to identify effective, replicable methods, to understand the conditions necessary for success in project-based learning, and to develop a more powerful theory and rationale to support project-based learning.

There is a need for both development and research at the intersection of cooperative learning and curriculum. Work at Johns Hopkins University and at the Success for All Foundation has for many years focused on development and evaluation of cooperative learning methods that are tied to particular subjects and grade levels, such as Cooperative Integrated Reading and Composition

(Stevens et al., 1987), WorldLab (social studies and science; Slavin & Madden, 2000) and MathWings (Madden et al., 2000). Elizabeth Cohen's (1994a) Complex Instruction program, and Eric Schaps' (Solomon et al., 1990) Child Development Project have also developed specific, broadly applicable curriculum materials to be used in a cooperative learning format. These contrast with most cooperative learning models, which typically provide some general guidance for how to adapt cooperative learning to different subjects and grade levels but rarely provide actual student materials. How is cooperative learning affected by the existence of specific materials? Does use of these materials improve the learning outcomes of cooperative learning? Does it make cooperative learning more likely to be implemented well in the first place and maintained over time? Or does the use of prepared materials lead to less thoughtful use of cooperative learning or less ability to adapt in situations lacking materials? These questions are more important for practice than for theory but they are very important for practice. Not incidentally, there is a need for development of high-quality well-developed, well-researched cooperative curricula in many subjects and grade levels, especially at the secondary level.

Related to the need for research on curriculum-based methods is a need for research on effective strategies for professional development and follow up to support cooperative learning. Nearly all cooperative learning training programs make extensive use of simulations. It is at least worth documenting the effectiveness of this practice. There has been some research on the effectiveness of peer coaching to support implementations of cooperative learning (e.g., Joyce, Calhoun, & Hopkins, 1999). Yet there is much more work to be done to identify strategies for professional development likely to lead to high-quality, thoughtful, and sustained implementation. A few factors worth studying might include contrasts between schoolwide and teacher-by-teacher implementations, expert versus peer coaches, inservice focusing on generic principles versus specific strategies, and use of teacher learning communities (Calderón, 2000), that is, groups of teachers who meet on a regular basis to support each other's innovative efforts.

This chapter has focused on the achievement outcomes of cooperative learning, but many of the other outcomes mentioned earlier are in need of further research. In particular, further research is needed on the effects of cooperative learning on intergroup relations, self-esteem, attitudes toward schooling, acceptance of mainstreamed classmates, prosocial norms, and other outcomes (see Hawley & Jackson, 1995; Slavin, 1995).

In general, there is a need for more research on all outcomes for older students (senior high schools and postsecondary institutions), and a need for development and evaluations of cooperative methods for young children, especially those in prekindergarten, kindergarten, and first grade.

In summary, although cooperative learning has been studied in an extraordinary number of field experiments of high-methodological quality, there is still much more to be done. Cooperative learning has the potential to become a primary format used by teachers to achieve both traditional and innovative goals. Research must continue to provide the practical, theoretical, and intellectual underpinnings to enable educators to achieve this potential. This chapter has advanced a cohesive model of the relationships among the important variables involved in the functioning of cooperative learning. It offers a framework for discussion and continued debate while calling for a move away from competitive attempts to explain this complex phenomenon toward a unified theoretical model which can guide future research efforts and inform education practice.

REFERENCES

Albury, A. (1993). *Social orientations, learning conditions and learning outcomes among low-income* Black and White *grade school children*. Unpublished doctoral dissertation, Howard University, Washington, DC.

Alfassi, M. (1998). Reading for meaning: the efficacy of reciprocal teaching in fostering reading comprehension in high school students in remedial reading classes. *American Educational Research Journal, 35*(2), 309–332.

Allen, S. D. (1991). Ability grouping research reviews: What do they say about grouping and the gifted? *Educational Leadership, 48*(6), 60–65.

Ames, G. J., & Murray, F. B. (1982). When two wrongs make a right: Promoting cognitive change by social conflict. *Developmental Psychology, 18*, 894–897.

Antil, L. R., Jenkins, J. R., Wayne, S., & Vadasy, P. F. (1998) Cooperative learning: Prevalence, conceptualizations, and the relation between research and practice. *American Educational Research Journal, 35*(3), 419–454.

Aronson, E., Blaney, N., Stephan, C., Sikes, J., & Snapp, M. (1978). *The Jigsaw classroom.* Beverly Hills, CA: Sage.

Ashman, A. F., & Gillies, R. M. (1997). Children's cooperative behavior and interactions in trained and untrained workgroups in regular classrooms. *Journal of School Psychology, 7*(1), 261–279.

Barbato, R. (2000). *Policy implications of cooperative learning on the achievement and attitudes of secondary school mathematics students*. Unpublished doctoral dissertation, Fordham University, New York, NY.

Battisch, V., Solomon, D., & Delucci, K. (1993). Interaction process and student outcomes in cooperative learning groups. *Elementary School Journal, 94*(1), 19–32.

Bell, N., Grossen, M., & Perret-Clermont, A.-N. (1985). Socio-cognitive conflict and intellectual growth. In M. Berkowitz (Ed.), *Peer conflict and psychological growth.* San Francisco, CA: Jossey-Bass.

Berg, K. F. (1993, April). *Structured cooperative learning and achievement in a high school mathematics class.* Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Berk, L. E. (Ed.). (2009). *Child development* (8th ed.). Boston, MA: Pearson.

Bershon, B. L. (1992). Cooperative problem solving: A link to inner speech. In R. Hertz-Lazarowitz & N. Miller (Eds.), *Interaction in cooperative groups* (pp. 36–48). New York, NY: Cambridge University Press.

Boykin, A. W. (1994). Afrocultural expression and its implications for schooling. In E. Hollins, J. King, & W. Hayman (Eds.), *Teaching diverse populations: Formulating a knowledge base* (pp. 243–257). Albany: State University of New York Press.

Boykin, A. W., & Ellison, C. (1995). The multiple ecologies of black youth socialization: An Afrographic analysis. In R. T. Taylor (Ed.), *African-American youth: Their social and economic status in the United States*. Westport, CT: Greenwood Press.

Burns, M. (1981, September). Groups of four: Solving the management problem. *Learning*, 46–51.

Calderón, M. (November/December, 2000). Teachers' Learning communities for highly diverse classrooms. *National Association for Bilingual Education Journal, 24*(2), 33–34.

Calderón, M., Hertz-Lazarowitz, R., & Slavin, R. E. (1998). Effects of bilingual cooperative integrated reading and composition on students making the transition from Spanish to English reading. *Elementary School Journal, 99*(2), 153–165.

Calhoon, M., Al Otaiba, S., Cihak, D., King, A., & Avalos, A. (2007). The effects of a peer-mediated program on reading skill acquisition for two-way bilingual first-grade classrooms. *Learning Disability Quarterly, 30*(3), 169–184.

Cameron, J., & Pierce, W. D. (1994). Reinforcement, reward, and intrinsic motivation: A meta-analysis. *Review of Educational Research, 64*(3), 363–423.

Cameron, J., & Pierce, W. D. (1996). The debate about rewards and intrinsic motivation: Protests and accusations do not alter the results. *Review of Educational Research, 66*(1), 39–51.

Carter, C. J. (1997). Why reciprocal teaching? *Educational Leadership, 54*, 64–68.

Cavanagh, B. R. (1984). Effects of interdependent group contingencies on the achievement of elementary school children. *Dissertation Abstracts, 46*, 1558.

Chamberlain, A., Daniels, C., Madden, N. A., & Slavin, R. E. (2007). A randomized evaluation of the Success for All Middle School reading program. *Middle Grades Reading Journal, 2*(1), 1–22.

Chambers, B., & Abrami, P. C. (1991). The relationship between student team learning outcomes and achievement, causal attributions, and affect. *Journal of Educational Psychology, 83*, 140–146.

Chapman, E. (2001, April). *More on moderators in cooperative learning outcomes*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.

Cohen, E. (1986). *Designing groupwork: Strategies for the heterogeneous classroom.* New York, NY: Teachers College Press.

Cohen, E. G. (1994a). *Designing groupwork: Strategies for the heterogeneous classroom* (2nd ed.). New York, NY: Teachers College Press.

Cohen, E. G. (1994b). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*(1), 1–35.

Coleman, J. (1961). *The adolescent society.* New York, NY: Free Press.

Coleman, K. (1998). *The influence of communal learning contexts on black and white third and sixth grade students' utilization of metacognitive strategies and behaviors*. Unpublished doctoral dissertation, Howard University, Washington, DC.

Cooper, R., & Slavin, R. E. (2004). Cooperative learning: An instructional strategy to improve intergroup relations. In W. G. Stephan & W. P. Vogt (Eds.), *Education programs for improving intergroup relations*. New York, NY: Teachers College Press.

Damon, W. (1984). Peer education: The untapped potential. *Journal of Applied Developmental Psychology, 5*, 331–343.

Dansereau, D. F. (1988). Cooperative learning strategies. In C. E. Weinstein, E. T. Goetz, & P. A. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation* (pp. 103–120). Orlando, FL: Academic Press.

David, J. (2008). Project-based learning. *Educational Leadership, 65*(5), 80–84.

Davidson, N. (1985). Small-group learning and teaching in mathematics: A selective review of the research. In R. E. Slavin, S. Sharan, S. Kagan, R. Hertz-Lazarowitz, C. Webb, & R. Schmuck (Eds.), *Learning to cooperating to learn* (pp. 211–230). New York, NY: Plenum Press.

DeAvila, E., & Duncan, S. (1980). *Finding out/descubrimiento.* Corte Madera, CA: Linguametrics.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). The undermining effect is a reality after all—Extrinsic rewards, task interest, and self-determination: Reply to Eisenberger, Pierce, and Cameron. *Psychological Bulletin, 125*(6), 692–700.

Devin-Sheehan, L., Feldman, R., & Allen, V. (1976). Research on children tutoring children: A critical review. *Review of Educational Research, 46*(3), 355–385.

Ellis, A. K., & Fouts, J. T. (1993). *Research on educational innovations.* Princeton Junction, NJ: Eye on Education.

Fantuzzo, J. W., King, J. A., & Heller, L. R. (1992). Effects of reciprocal peer tutoring on mathematics and school adjustment: A component analysis. *Journal of Educational Psychology, 84*, 33–339.

Fantuzzo, J. W., Polite, K., & Grayson, N. (1990). An evaluation of reciprocal peer tutoring across elementary school settings. *Journal of School Psychology, 28*, 309–323.

Fantuzzo, J. W., Riggio, R. E., Connelly, S., & Dimeff, L. A. (1989). Effects of reciprocal peer tutoring on academic achievement and psychological adjustment: A component analysis. *Journal of Educational Psychology, 81*, 173–177.

Feldman, R. S. (Ed.). (2010). *Child development*. Upper Saddle River, NJ: Prentice Hall.

Foyle, H. C., Lyman, L. R., Tompkins, L., Perne, S., & Foyle, D. (1993). Homework and cooperative learning: A classroom field experiment. *Illinois School Research and Development, 29*(3), 25–27.

Fuchs, L., Fuchs, D., & Karns, K. (2001). Enhancing kindergarteners' mathematical development: Effects of peer-assisted learning strategies. *Elementary School Journal, 101*(5), 495–510.

Fuchs, L., Fuchs, D., Kazdan, S., & Allen, S. (1999). Effects of peer-assisted learning strategies in reading with and without training in elaborated help giving. *Elementary School Journal, 99*(3), 201–220.

Fuchs, L., Fuchs, D., Yazdian, L., & Powell, S. (2002). Enhancing first-grade children's mathematical development with peer-assisted learning strategies. *School Psychology Review, 31*(4), 569–583.

Garibaldi, A. (1979). Affective contributions of cooperative and group goal structures. *Journal of Educational Psychology, 71*, 788–794.

Graham, S. (2006). Strategy instruction and the teaching of writing: A meta-analysis. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 187–207). New York, NY: Guilford Press.

Greenwood, C. R., Delquadri, J. C., & Hall, R. V. (1989). Longitudinal effects of classwide peer tutoring. *Journal of Educational Psychology, 81*, 371–383.

Harris, K. R., Graham, S., & Mason, L. (2006). Improving the writing, knowledge, and motivation of struggling young writers: Effects of self-regulated strategy development with and without peer support. *American Educational Research Journal, 43*(2), 295–340.

Hart, E. R., & Speece, D. L. (1998). Reciprocal teaching goes to college: Effects for post-secondary students at risk for academic failure. *Journal of Educational Psychology, 90*(4), 670–681.

Hawley, W. D., & Jackson, A. W. (Eds.). (1995). *Toward a common destiny: Improving race and ethnic relations in America*. San Francisco, CA: Jossey-Bass.

Haynes, N. M., & Gebreyesus, S. (1992). Cooperative learning: A case for African-American students. *School Psychology Review, 21*(4), 577–585.

Hogg, M. A. (1987). Social identity and group cohesiveness (pp. 89–116). In J. C. Turner (Ed.), *Rediscovering the social group: A self-categorization theory*. New York, NY: Basil Blackwell.

Huber, G. L., Bogatzki, W., & Winter, M. (1982). *Kooperation als Ziel schulischen Lehrens und Lehrens*. Tubingen, West Germany: Arbeitsbereich Padagogische Psychologie der Universitat Tubingen.

Hurley, E. A. (1999, April). *The cultural significance of communal group learning to the mathematics achievement and motivation of African-American children*. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Johnson, D., & Johnson, R. (1979). Conflict in the classroom: Controversy and learning. *Review of Educational Research, 49*, 51–70.

Johnson, D., & Johnson, R. (1983). Social interdependence and perceived academic and personal support in the classroom. *Journal of Social Psychology, 120*, 77–82.

Johnson, D., & Johnson, R. (1985). The internal dynamics of cooperative learning groups. In Slavin, R., Sharan, S. S., Kagan, S. Lazarowitz, R. H. Webb, C., & Schmuck, R. (Eds.), *Learning to cooperate: Cooperating to learn* (103–123). New York, NY: Plenum Press.

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research*. Edina, MN: Interaction Book.

Johnson, D. W., & Johnson, R. T. (1999). *Learning together and alone: Cooperative, competitive, and individualistic learning* (4th ed.). Boston, MA: Allyn & Bacon.

Johnson, L. C. (1985). *The effects of the groups of four cooperative learning model on student problem-solving achievement in mathematics*. Unpublished doctoral dissertation, University of Houston, Houston, TX.

Johnson, L. C., & Waxman, H. C. (1985, March). *Evaluating the effects of the "groups of four" program*. Paper presented at the annual convention of the American Educational Research Association, Chicago, IL.

Jones, D. S. P. (1990). *The effects of contingency based and competitive reward systems on achievement and attitudes in cooperative learning situations*. Unpublished doctoral dissertation, Temple University, Philadelphia, PA.

Jordan, C. (1992, Fall). The role of culture in minority school achievement. *Kamehameha Journal of Education*.

Joyce, B., Calhoun, E., & Hopkins, D. (1999). *The new structure of social improvement*. Buckingham, UK: Open University Press.

Kagan, S. (1992). *Cooperative learning* (8th ed.). San Juan Capistrano, CA: Kagan Cooperative Learning.

Kaminski, L. B. (1991). *The effect of formal group skill instruction and role development on achievement of high school students taught with cooperative learning*. Unpublished doctoral dissertation, Michigan State University, Lansing, MI.

King, C. M., & Johnson-Parent, L. M. (1999). Constructing meaning via reciprocal teaching. *Reading Research and Instruction, 38*(3), 169–186.

Kohn, A., (1986). *No contest: The case against competition*. Boston, MA: Houghton-Mifflin.

Kuhn, D. (1972). Mechanism of change in the development of cognitive structures. *Child Development, 43*, 833–844.

Kutnick, P., Ota, C., & Berdondin, L. (2008). Improving the effects of group working in classrooms with young school-aged children: Facilitating attainment, interaction and classroom activity. *Learning and Instruction, 18*(1), 83–95.

Latane, B., Williams, K., & Harkins, S. (1979). Many hands make light the work: The causes and consequences of social loafing. *Journal of Personality and Social Psychology, 37*, 822–832.

Lederer, J. M. (2000). Reciprocal teaching of social studies in inclusive elementary classrooms. *Journal of Learning Disabilities, 33*(1), 91–106.

Leikin, R., & Zaslavsky, O. (1997). Facilitating student interactions in mathematics in a cooperative learning setting. *Journal for Research in Mathematics Education, 28*(3), 331–354.

Lepper, M. R., Henderlong J., & Gingras, I. (1999) Understanding the effects of extrinsic rewards on intrinsic motivation: Uses and abuses of meta-analysis: Comment on Deci, Koestner and Ryan (1999). *Psychological Bulletin, 124*(6), 669–676.

Lepper, M. R., Keavney, M., & Drake, J. (1996). Intrinsic motivation and extrinsic rewards: A commentary on Cameron and Pierce's meta-analysis. *Review of Educational Research, 66*(1), 5–32.

Madden, N. A., Slavin, R. E., & Simons, K. (2000). *MathWings: Effects on student Mathematics performance*. Baltimore, MD: Johns Hopkins University Center for Research on the Education of Students Placed at Risk.

Maheady, L., Harper, G. F., & Mallette, B. (1991). Peer-mediated instruction: Review of potential applications for special education. *Reading, Writing, and Learning Disabilities, 7*, 75–102.

Manning, M. L., & Lucking, R. (1991, May/June). The what, why, and how of cooperative learning. *Social Studies*, 120–124.

Mathes, P., & Babyak, A. (2001). The effects of peer-assisted literacy strategies for first-grade readers with and without additional mini-skills lessons. *Learning Disabilities Research & Practice, 16*(1), 28–44.

Mathes, P. G., Torgesen, J. K., Clancy-Menchetti, J., Santi, K., Nicholas, K., Robinson, C., & Grek, M. (2003). A comparison of teacher-directed versus peer-assisted instruction to struggling first-grade readers. *Elementary School Journal, 103*(5), 461–479.

Mattingly, R. M., & Van Sickle, R. L. (1991). Cooperative learning and achievement in social studies: Jigsaw II. *Social Education, 55*(6), 392–395.

Meloth, M. S., & Deering, P. D. (1992). The effects of two cooperative conditions on peer group discussions, reading comprehension, and metacognition. *Contemporary Educational Psychology, 17*, 175–193.

Meloth, M. S., & Deering, P. D. (1994). Task talk and task awareness under different cooperative learning conditions. *American Educational Research Journal, 31*(1), 138–166.

Mergendoller, J., & Packer, M. J. (1989). *Cooperative learning in the classroom: A knowledge brief on effective teaching*. San Francisco, CA: Far West Laboratory.

Moody, J. D., & Gifford, V. D. (1990, November). *The effect of grouping by formal reasoning ability levels, group size, and gender on achievement in laboratory chemistry*. Paper presented at the annual meeting of the Mid-South Educational Research Association, New Orleans, LA.

Mugny, B., & Doise, W. (1978). Socio-cognitive conflict and structuration of individual and collective performances. *European Journal of Social Psychology, 8*, 181–192.

Murray, F. B. (1982). Teaching through social conflict. *Contemporary Educational Psychology, 7*, 257–271.

National Center for Education Statistics. (2000). *The condition of education 2000, NCES 2000–602*. Washington, DC: U.S. Government Printing Office.

Nelson, J. R., Johnson, A., & Marchand-Martella, N. (1996). Effects of direct instruction, cooperative learning, and independent learning practices on the classroom behavior of students with disorders: a comparative analysis. *Journal of Emotional and Behavioral Disorders, 4*(1) 53–62.

Newbern, D., Dansereau, D. F., Patterson, M. E., & Wallace, D. S. (1994, April). *Toward a science of cooperation*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Newmann, F. M., & Thompson, J. (1987). *Effects of cooperative learning on achievement in secondary schools: A summary of research*. Madison, WI: University of Wisconsin, National Center on Effective Secondary Schools.

Nichols, J. D. (1996). The effects of cooperative learning on student achievement and motivation in a high school geometry class. Brief research report. *Contemporary Educational Psychology, 21*, 467–476.

O'Donnell, A. M. (1996). The effects of explicit incentives on scripted and unscripted cooperation. *Journal of Educational Psychology, 88*(1), 74–86.

O'Donnell, A. M. (2000). Interactive effects of prior knowledge and material format on cooperative teaching. *Journal of Experimental Education, 68*(2), 101–108.

O'Donnell, A. M., & Dansereau, D. F. (1992). Scripted cooperation in student dyads: A method for analyzing and enhancing academic learning and performance. In R. Hertz-Lazarowitz & N. Miller (Eds.), *Interaction in cooperative groups: The theoretical anatomy of group learning* (pp. 120–144). New York, NY: Cambridge University Press.

Okebukola, P. A. (1985). The relative effectiveness of cooperative and competitive interaction techniques in strengthening students' performance in science classes. *Science Education, 69*, 501–509.

Okebukola, P. A. (1986). The influence of preferred learning styles on cooperative learning in science. *Science Education, 70*, 509–517.

Palincsar, A. S. (1987, April). *Reciprocal teaching: Field evaluations in remedial and content area reading*. Paper presented at the annual convention of the American Educational Research Association, Washington, DC.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension monitoring activities. *Cognition and Instruction, 2*, 117–175.

Palincsar, A. S., Brown, A. L., & Martin, S. M. (1987). Peer interaction in reading comprehension instruction. *Educational Psychologist, 22*, 231–253.

Parillo, V. N. (2008). *Understanding race and ethnic relations* (3rd ed.). Boston, MA: Allyn & Bacon.

Perret-Clermont, A. -N. (1980). *Social interaction and cognitive development in children*. London, UK: Academic Press.

Piaget, J. (1926). *The language and thought of the child*. New York, NY: Harcourt Brace.

Puma, M. J., Jones, C. C., Rock, D., & Fernandez, R. (1993). *Prospects: The congressionally mandated study of educational growth and opportunity. Interim report*. Bethesda, MD: Abt Associates.

Rich, Y., Amir, Y., & Slavin, R. E. (1986). *Instructional strategies for improving children's cross-ethnic relations*. Ramat Gan, Israel: Bar Ilan University, Institute for the Advancement of Social Integration in the Schools.

Robinson, G. E. (1990). Synthesis of research on class size. *Educational Leadership, 47*(7), 80–90.

Rohrbeck, C. A., Ginsburg-Block, M. D., Fantuzzo, J. W., & Miller, T. R. (2003). Peer-assisted learning interventions with elementary school students: A meta-analytic review. *Journal of Educational Psychology, 94*(2), 240–257.

Rosenshine, B., & Meister, C. (1994). Reciprocal teaching: A review of research. *Review of Educational Research, 64*, 479–530.

Saleh, M., Lazonder, A., & de Jon, T. (2007). Structuring collaboration in mixed-ability groups to promote verbal interaction, learning, and motivation of average-ability students. *Contemporary Educational Psychology, 32*(3), 314–331.

Sharan, S., & Hertz-Lazarowitz, R. (1980). A group-investigation method of cooperative learning in the classroom. In S. Sharan, P. Hare, C. Webb, & R. Hertz-Lazarowitz (Eds.), *Cooperation in education*. Provo, UT: Brigham Young University Press.

Sharan, S., Kussell, P., Hertz-Lazarowitz, R., Bejarano, Y., Raviv, S., & Sharan, Y. (1984). *Cooperative learning in the classroom: Research in desegregated schools*. Hillsdale, NJ: Erlbaum.

Sharan, S., & Shachar, C. (1988). *Language and learning in the cooperative classroom*. New York, NY: Springer-Verlag.

Sharan, Y., & Sharan, S. (1992). *Expanding cooperative learning through group investigation*. New York, NY: Teachers College Press.

Slavin, R. E. (1983a). *Cooperative learning*. New York, NY: Longman.

Slavin, R. E. (1983b). When does cooperative learning increase student achievement? *Psychological Bulletin, 94*, 429–445.

Slavin, R. E. (1985). Cooperative learning: Applying contact theory in desegregated schools. *Journal of Social Issues, 41*(3), 43–62.

Slavin, R. E. (1987). Cooperative learning: Where behavioral and humanistic approaches to classroom motivation meet. *Elementary School Journal, 88*, 9–37.

Slavin, R. E. (1991). Are cooperative learning and untracking harmful to the gifted? *Educational Leadership, 48*(6), 68–71.

Slavin, R. E. (1992). When and why does cooperative learning increase achievement? Theoretical and empirical perspectives. In R. Hertz-Lazarowitz & N. Miller (Eds.), *Interaction in cooperative groups: The theoretical anatomy of group learning* (pp. 145–173). New York, NY: Cambridge University Press.

Slavin, R. E. (1994). *Using student team learning* (2nd ed.). Baltimore, MD: Johns Hopkins University, Center for Social Organization of Schools.

Slavin, R. E. (1995). *Cooperative learning: Theory, research, and practice* (2nd ed.). Boston, MA: Allyn & Bacon.

Slavin, R. E. (1996). Cooperative learning: Theory, research, and implications for active learning. In D. Stern (Ed.), *Active learning*. Paris, France: Organization for Economic Co-operation and Development.

Slavin, R. E. (2010). Cooperative learning. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International encyclopedia of education* (3rd ed.). Oxford, UK: Elsevier.

Slavin, R. E., Daniels, C., & Madden, N. A. (2005). The success for all middle school: Adding content to middle grades reform. *Middle school journal, 36*(5), 4–8.

Slavin, R., & Lake, C. (2008). Effective programs in elementary mathematics; A best-evidence synthesis. *Review of Educational Research, 78*(3), 427–515. Winner of the 2009 AERA Review of Research Award.

Slavin, R. E., & Madden, N. A. (2000). Roots & wings: Effects of whole-school reform on student achievement. *Journal of Education for Students Placed at Risk*, *5*(1 & 2), 109–136.

Slavin, R. E., & Oickle, E. (1981). Effects of cooperative learning teams on student achievement and race relations: Treatment by race interaction. *Sociology of Education, 54*, 174–180.

Solomon, D., Watson, M., Schaps, E., Battistich, V., & Solomon, J. (1990). Cooperative learning as part of a comprehensive classroom program designed to promote prosocial development. In S. Sharan (Ed.), *Cooperative learning: Theory and research*. New York, NY: Praeger.

Stevens, R. J., Madden, N. A., Slavin, R. E., & Farnish, A. M. (1987). Cooperative Integrated Reading and Composition: Two field experiments. *Reading Research Quarterly, 22*, 433–454.

Stevens, R. J., & Slavin, R. E. (1995a). Effects of a cooperative learning approach in reading and writing on academically handicapped and nonhandicapped students. *Elementary School Journal, 95*(3), 241–262.

Stevens, R. J., & Slavin, R. E. (1995b). The cooperative elementary school: Effects on students' achievement, attitudes, and social relations. *American Educational Research Journal, 32*, 321–351.

Stevens, R. J., Slavin, R. E., & Farnish, A. M. (1991). The effects of cooperative learning and direct instruction in reading comprehension strategies on main idea identification. *Journal of Educational Psychology, 83,* 8–16.

Talmage, H., Pascarella, E. T., & Ford, S. (1984). The influence of cooperative learning strategies on teacher practices, student perceptions of the learning environment, and academic achievement. *American Educational Research Journal, 21*, 163–179.

Tharp, R., & Gallimore, R. (1988). *Rousing minds to life*. New York, NY: Cambridge University Press.

Turner, J. C. (1987). *Rediscovering the social group: A self-categorization theory*. New York, NY: Basil Blackwell.

Van Keer, H., & Verhaeghe, J. (2005). Comparing two teacher development programs for innovating reading comprehension instruction with regard to teachers' experiences and student outcomes. *Teaching and Teacher Education, 21*, 543–562.

Van Keer, H., & Verhaeghe, J. (2008). *Strategic reading in peer tutoring dyads in second- and fifth-grade classrooms*. Unpublished report. Ghent University, Belgium.

Van Oudenhoven, J. P., Van Berkum, G., & Swen-Koopmans, T. (1987). Effect of cooperation and shared feedback on spelling achievement. *Journal of Educational Psychology, 79*, 92–94.

Van Oudenhoven, J. P., Wiersma, B., & Van Yperen, N. (1987). Effects of cooperation and feedback by fellow pupils on spelling achievement. *European Journal of Psychology of Education, 2*, 83–91.

Vygotsky, L. S. (1978). *Mind in society* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.

Wadsworth, B. J. (1984). *Piaget's theory of cognitive and affective development* (3rd ed.). New York, NY: Longman.

Webb, N. M. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research, 13*, 21–39.

Webb, N. M. (1992). Testing a theoretical model of student interaction and learning in small groups. In R. Hertz-Lazarowitz & N. Miller (Eds.), *Interaction in cooperative groups: The theoretical anatomy of group learning* (pp. 102–119). New York, NY: Cambridge University Press.

Webb, N. M. (2008). Learning in small groups. In T. L. Good (Ed.), *21st century education: A reference handbook* (pp. 203–211). Los Angeles, CA: Sage.

Webb, N. M., & Farivar, S. (1994) Promoting helping behavior in cooperative small groups in middle school mathematics. *American Educational Research Journal, 31* (2), 369–395.

Webb, N. M., & Mastergeorge, A. M. (2003). The development of students' learning in peer-directed small groups. *Cognition and Instruction, 21*, 361–428.

Wheeler, R., & Ryan, F. L. (1973) Effects of cooperative and competitive classroom environments on the attitudes and achievement of elementary school students engaged in social studies inquiry activities. *Journal of Educational Psychology, 65*, 402–407.

Williams, K., & Karau, S. (1991). Social loafing and social compensation: The effects of expectations of co-worker performance. *Journal of Personality and Social Psychology, 61* (4), 570–581.

Wittrock, M. C. (1986). Students' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.) New York, NY: Macmillan.

Yost, C. A., & Tucker, M. L. (2000, Spring). Are effective teams more emotionally intelligent? Confirming the importance of effective communication in teams. *Delta Pi Epsilon Journal, 42* (2), 101–109.

Zahn, G., Kagan, S., & Wideman, K. (1986). Cooperative learning and classroom climate. *Journal of Social Psychology, 24*, 351–362.

Zmuda, A. (2008). Springing into active learning. *Educational Leadership, 66* (3), 38–43.

CHAPTER 9

Relationships Between Teachers and Children

TERRI J. SABOL AND ROBERT C. PIANTA

RELATIONSHIPS BETWEEN TEACHERS AND CHILDREN

Children's relationships with teachers have been a focus of educators' concern for decades. Evidence suggests that relationships with at least one caring adult, not necessarily a parent, is perhaps the single most important element in protecting young people who have multiple risks in their lives (e.g., Carnegie Council on Adolescent Development, 1989; Gambone, Klem, & Connell, 2002; Resnick et al., 1997), and for many children this adult is a teacher. A wide and diverse array of theoretical and methodological traditions have been engaged in the effort to better understand the role of teacher-child relationships in order to improve the experiences of students, some of which were summarized in Pianta (1999) and then again in 2003 (Pianta, Hamre, & Stuhlman, 2003) in a review of empirical findings that serves as the starting point for the present chapter. The conceptual framework set forth in Pianta et al. (2003) appeared promising for advancing a line of inquiry and applied work as well as helping extend theories about the nature and value of adult-child relationships in human development; however, the theoretical and empirical support for teacher-child relationships was still in its nascent stages.

Based on theoretical support and emerging evidence at the time, Pianta and colleagues (2003) recommended a number of critical areas of research required to move the field forward and continue the necessary integration between disciplines and historically separate strands of research. The goal of this chapter is to consider these recommended areas of research in light of intervening findings and new domains of work that have implications for the further understanding of the nature and impacts of relationships between teachers and children.

Conceptual and Methodological Considerations

Before moving to a more detailed review of empirical findings, we present the framework proposed by Pianta and colleagues (2003) as well as the current methodologies typically in use in the teacher-child relationship literature. Pianta and colleagues concluded that a focus on relational processes and units could promote understanding of on children's development in classrooms. Building on attachment theory, which focuses on relationships as central to children's development, the conceptual model provided a developmental systems theory perspective on this emerging area of scientific and applied interest. Under developmental system theory, also referred to as an ecologically oriented system theory, children are embedded in organized and dynamic systems that include multiple proximal and distal levels of influence. At the most

The development of this paper was supported in part by a grant awarded to Dr. Robert Pianta and colleagues by the Institute of Education Sciences, U.S. Department of Education, through Grant R305B040049 to the University of Virginia. The opinions expressed are those of the authors and do not represent views of the U.S. Department of Education.

proximal level, teacher-child relationships are a product of individual teacher and child characteristics, which are reciprocal and bidirectional (Pianta et al., 2003). For instance, children's previous relational models with adults may guide their interactions with teachers; however, a sensitive teacher may reshape children's relational models, and subsequent behavior and relationships.

Further broadening beyond this dyadic paradigm, developmental systems theory emphasizes that relationships are embedded within a multilevel system, where each level, including community, classroom, family, and individual attributes, has a dynamic bidirectional influence on relational processes (Bronfenbrenner & Morris, 1998; Lerner, 1998; Sameroff, 1995). The within- and cross-level interactions form patterns of interactions between children and teachers that are the basis for the formation of teacher-child relationships. The temporal interactions and subsequent relationships are the primary mechanism in which children develop and learn.

In terms of methodology, a number of empirical studies using child-report and teacher-report assessments demonstrate that features of the conceptual model of teacher-child relationships can be reliably assessed. From a *teacher's perspective*, features of the relationship such as a sense of closeness, dependency, or conflict have been cross-validated in several studies (Birch & Ladd, 1997; Cost, Quality and Outcomes Study Team, 1995; Saft & Pianta, 2001), from prekindergarten through fifth grade. Closeness refers to the degree of warmth and positive affect between the teacher and the child, as well as how comfortable the child is approaching the teacher. Conflict refers to the negativity or lack of rapport between the teacher and child and appears to be the factor most strongly related to child outcomes when teachers' views of the relationship are assessed and dependency refers to the extent in which the child displays clinginess or possessiveness with the teacher (Mashburn & Pianta, 2006).

Older *children's perceptions* of the qualities of relationships are typically assessed using questionnaires that focus on emotional aspects of classrooms. Questionnaires such as the Emotional Quality Scale of the Relatedness Questionnaire (Lynch & Cicchetti, 1997), the Quality of Student-Teacher Relationship Scale (Davis, 2001) and the Network of Relationships Inventory (Furman & Buhrmester, 1985; Meehan, Hughes, & Cavell, 2003) show promising results in terms of assessing children's perceptions of the emotional quality of their relationships with teachers, assessing key constructs such as *perceived support*, *utilization* (willingness to rely on the teacher), and *sense of relatedness* (the extent to which students feel successful in their bids for belonging and sense of acceptance).

In addition, *observations* have played a key role in understanding relational quality and the degree in which classroom climate can be characterized by emotional support and connectivity (Howes, Hamilton, & Matheson, 1994; Ladd, Birch, & Buhs, 1999; Pianta, La Paro, & Hamre, 2007). In line with developmental systems theory, teachers who are highly sensitive create an emotionally supportive climate in their classroom, which benefits the development of more positive dyadic teacher-child relationships (Ahnert, Pinquart, & Lamb, 2006; Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008). Observed teacher-student interaction s are another valid source of information for understanding relational quality in the classroom (Pianta et al., 2007). In the present review, we differentiate between studies' methodologies in terms of their reliance on observed interactions, teachers' perceptions of relationships, and children's perceptions of relationships.

EXAMINING THE GOALS OF THE 2003 REVIEW A DECADE LATER

At the time of the Pianta et al. (2003) review, the conceptual framework and empirical support for understanding children's development in school settings through a relational focus was still developing. The review concluded by identifying five key areas of research needed to propel the field forward. To begin, Pianta and colleagues (2003) recommended exploring the extent to which early relational models formed with parents apply to subsequent caregiving relationships and the extent to which individual characteristics influence the concordance across relationships. Second, Pianta et al. suggested the need to examine differing components of teacher-child relationships are associated with children's outcomes in early childhood compared to elementary school and middle school. The third recommended area was to examine whether teacher-child relationships serve as moderators of developmental change for at-risk children. The fourth recommended area focused on extent to which systematic professional development programs have the potential to improve teacher-child relationships, and in turn, improve children's development and learning. Pianta et al. also recommended a fifth area, which was to understand the continuity of relationships across contexts or across teachers. However, because scant research has been conducted exploring this question we discuss this limitation, and its consequences, in the conclusion section. It is our intent that this systematic integration of intervening findings will highlight and integrate the advancements in these recommended research areas.

Concordance Between Relationships With Parents and Teachers

Children form attachment with mothers, or primary caregivers, well before they enter school. Aligned with attachment theory, children's early attachment with their mothers guides the formation of internal models of relationships. These mental representations formed with early caregivers subsequently direct the interpretation and behavior of other relational partners (i.e., teachers; Buyse, Verschueren, & Doumen, 2009; Rydell, Bohlin, & Thorell, 2005; Zajac & Kobak, 2006). Recently, theorists have integrated developmental system theory with attachment theory in order to better understand the concordance between relationships with parents and teachers. Research at the cross-section of these two theories postulate that teacher/caregiver characteristics, such as sensitivity, may change the internal working models children developed with parents and revise children's previous mental representations of relationships. The following section examines the empirical evidence for continuity from parent-child to teacher-child relationships, applying an attachment framework, as well as a developmental system model, in order to better understand the extent to which relational models formed by early attachment extend across children's relationships.

To begin, it appears that children's security with parents is related to children's security with teachers/caregivers in toddlerhood. Booth, Kelly, Spieker, and Zuckerman (2003) used the same measure at 24 months to assess observed mother-child and caregiver-child attachment (Attachment Q-Set). Using a subset of items that applied to both mothers and caregivers, they found a significant correlation between the safe-haven/secure-base composite score, suggesting that secure attachment generalizes from mothers to teachers in toddlerhood. Because findings are correlational, the reason for this concordance between mother and teacher attachment is empirically unknown. It may be that children's relational models formed with mothers influence their ability to use a caregiver as a secure base, but as noted by Booth and colleagues (2003), it may be that selection bias leads to the association, where sensitive mothers select sensitive caregivers. Additionally, it may be that children's characteristics, such as temperament, may drive the association, rather than their relational models.

The concordance between maternal security and teacher/caregiver security continues into preschool, albeit modestly (Ahnert et al., 2006; Sroufe, 1989). Ahnert, Pinquart, and Lamb's (2006) meta-analysis examined the extent to which observed security with teachers matches observed security with parents. Although there were significant differences in security between certain groups of children (e.g., girls had more secure relationships than boys) and context (children in home-based care had more secure relationships than in center-based care), children's security with parents was significantly correlated with children's security with teachers. Results are further corroborated in a study that used teachers' perceptions of closeness to measure relational quality. O'Connor and McCartney (2006) found that insecure children had lower quality relationships with teachers than securely attached children throughout early childhood.

The moderately significant relation between parent-child and teacher-child relationships suggests that there are other child or teacher characteristics that may influence, attenuate, or strengthen this association (O'Connor & McCartney, 2007). Attachment-based theory suggests that the development of secure adult-child relationships is related to adults' sensitivity; however, few studies have tested these characteristics as moderators for the relations between parent-child and teacher-child relationships. One exception is a study by Buyse and colleagues (2009) that investigated the role of teacher sensitivity as a protective or exacerbating factor in the relation between maternal attachment quality and the relationship with the teacher. They found continuity of relationship problems when observed teacher sensitivity was low; children with insecure attachment continued to have less close relationships with teachers when the teacher was less sensitive compared to securely attached children. When teachers were highly sensitive, children with less secure attachments were no longer at risk for developing conflictual relationships with teachers. Findings suggest that the quality of teacher-child relationships is not only influenced by children's attachment history, but also teachers' sensitivity.

In early childhood, teachers' roles often parallel parental roles, with teachers providing support and giving evaluative feedback as children navigate the classroom environment (Hamre & Pianta, 2001; Myers & Pianta, 2008; O'Connor & McCartney, 2006). As children develop and they internalize relational models, early relationships with teachers appear particularly important for later relationships with teachers, and evidence indicates that teacher report of closeness with children is relatively stable across early schooling years. For instance, O'Connor and McCartney (2006) found that children's relationship quality with teachers at 54 months more strongly predicted kindergarten and first grade teacher-child relationships than maternal attachment.

Results may suggest that early relationships with teachers may help to form children's internal models that are applied to subsequent teachers; however, there is evidence suggesting a more transactional model. For instance, a children's supportive relationship with a teacher is associated with an increase in a child's sense of engagement to the school setting, which may in turn enhance the child's connectedness to the next teacher (Hughes, Luo, Kwok, & Loyd, 2008), demonstrating the increasing complexity in trying to understand the influence of maternal attachment.

The association between maternal attachment in late elementary school/middle school and children's functioning dissipates as additional factors are associated the quality of teacher-child relationships, including exposure to multiple teachers across a school year and the increasing importance of peers (Roeser & Galloway, 2002). From a research perspective, it is particularly difficult to examine the influence of maternal attachment or early caregiving relationship quality on relationship quality in middle school because of the difference in measurement approaches—relationship quality is often based on students' perceived support, which is most strongly supported by a social-motivational framework (e.g., Baker, 2006; Furrer & Skinner, 2003). Interestingly, students' perceived support seems to be intricately tied to parental support. Barber and Olsen (2004) found that a less steep decrease in perceived teacher-support was associated with a less steep increase in parent-child conflict; however, researchers are still beginning to unpack the complex pattern of students' perceived support, parental relationships, and the sensitivity of relationships to particular contexts and stages of students' development.

In sum, consistent with attachment theory, children's early patterns of maternal attachment are moderately associated with teacher/caregiver relationship quality in early childhood. Upon exposure to nonparental caregiving experiences, interactions with teachers, particularly sensitivity, have the potential to modify relational schema, and offer unique opportunities to buffer poor attachment histories. As children internalize relational models and become less dependent on adults to help navigate their environment, the association with maternal attachment dissipates. Thus far, the increased integration between attachment theory and the development system framework has led to important insights about the complexity of forming positive relationships with teachers.

ASSOCIATIONS BETWEEN TEACHER-CHILD RELATIONSHIPS AND OUTCOMES ACROSS THE SCHOOL YEARS

A key feature of the conceptual framework described in Pianta et al. (2003) is that although child-adult relationships are bidirectional, they are also asymmetric in the sense that it is fundamental to the teacher role that teachers have responsibility for fostering development more intentionally and actively. This feature of a teacher's role varies across age and grade depending on children's developmental maturity and capability to form relationships. Thus, it may be postulated that different components of child-teacher relationships are related to different outcome domains for children and teachers at different ages or grades. However, to date, there is little domain-specific evidence on the influence of teacher-child relationships throughout early childhood, elementary school and middle school and even less research regarding domain-specific relations with different domains of functioning across schooling.

One main reason for this paucity of longitudinal research is due to measurement differences between early childhood and later elementary school/middle school. In early childhood, researchers measure the quality of relationships through teacher reports. Teachers tend to report relationships in terms of conflict and negativity. Teacher-reported conflict tends to be the most salient predictor of early childhood outcomes above all other domains of teacher-child relationships. In late elementary school and middle school, researchers largely use student-reports of the quality of relationships. Children tend to report emotional closeness and support, communication and involvement. The differences in measurement between early childhood and middle school has led to a substantial divide in the literature, with little evidence on domain stability or influence across multiple outcomes from prekindergarten to eighth grade, and virtually no work exploring how different components of teacher-child relationships relate to different outcomes across school.

Although there is little evidence across age groups, there is some empirical support that the quality of relationships changes within each age group and this change is related to children's outcomes. Across early childhood and elementary school, it appears that children's closeness with teachers decreases, yet despite this drop, closeness continues to have important linkages to outcomes (Baker, 2006). O'Connor and McCartney (2007) found that children with *declining* closeness over early elementary school had the lowest achievement in third grade compared to groups that had stable or increasing closeness. Additionally, there is some evidence that the relation between components of teacher-child relationships and outcomes is moderated by child-level characteristics. For instance, Burchinal, Peisner-Feinberg, Pianta, and Howes (2002) examined how teacher-child relationships contributed to children's academic skills from preschool through second grade among children with varying parental quality. For children whose parents reported *more* progressive parenting attitudes, closeness with teacher predicted reading gains during preschool, but not kindergarten or second grade. For children whose parents reported *less* progressive parenting attitudes, closeness with teacher predicting reading gains in kindergarten and second grade, but not preschool. And also in preschool, Mashburn et al. (2008) reported that emotional features of interactions predicted gains in children's social behavior while cognitive features predicted growth in academic skills.

Aside from closeness, the influence of dependency on children's outcomes seems to shift in early childhood. Palermo, Hanish, Martin, Fabes, and Reiser (2007) found that the association between teacher-reported dependency and academic readiness was strengthened according to children's age within preschool. For younger children, the relation between high teacher dependency and achievement was relatively similar to children with low teacher dependency. For older children, having high teacher dependency was particularly detrimental to academic achievement, compared to low teacher dependency.

The changes of perceived teacher support in middle school also seem to have a significant impact on children's functioning. Reddy, Rhodes, and Mulhall (2003) found that decreasing perceptions of teacher support was associated with increases in depression and decreases in self-esteem. Although perceived support decreases in middle school, teacher support seems particularly important for adolescent well-being. For example, despite the evidence that students' perceived support drops in sixth grade, the effect of children's sense of relatedness on self-esteem and depressive symptoms was the strongest for sixth grade students compared to students in younger grades (Furrer & Skinner, 2003). Using data from the Institute for Research and Reform, Klem and Connell (2004) found that high levels of support tend to benefit middle school students' engagement more substantially than elementary school students. Conversely, elementary school students' engagement tends to be more adversely affected by low teacher support compared to middle school students.

Understanding of the domains of teacher-child relationships in middle school is somewhat less developed than in early childhood. In addition to understanding how decreases in perceived support are related to student outcomes in middle school, there is also new evidence that examines how certain components of teacher-child relationships are differentially related to student outcomes. Murray (2009) examined the associations of student reported relationships with teachers with predominately low-income Latino adolescents. The most salient aspects of student-teacher relationships were warmth, trust, involvement, and expectations. Only closeness was associated with engagement and math achievement. Positive involvement was associated with teacher-reported language achievement. Results suggest student's perceptions of having supporting and positive relationships with teachers influenced their performance and engagement in the classroom. Interestingly, the most salient predictors of student adjustment and competency in late elementary and middle school were the positive aspects of relationships. This is in contrast to the domains of teacher-child relationship that are important for younger children; negativity, conflict and dependency tend to be the most salient predictors of concurrent functioning among preschool-aged children (Pianta et al., 2003).

In sum, although there seems to be some momentum for understanding of how dimensions of relationships influence different children's outcomes across time, this area of research is somewhat thwarted by the bifurcation of measurement and conceptualization of teacher-child relationships across early childhood and middle school. To date, research in this area has mostly explored the change of relationship quality within each time period (e.g., early childhood), as well as the association between domain-specific relational constructs and children's outcomes and potential moderators. Overall, in order to better understand whether different qualities of teacher-child relationships are related to different outcome domains for children and teachers at different ages or grades, the field needs to develop more cohesive measurement tools across early childhood and middle school.

Moderating Role of Teacher-Child Relationships in Relation to Risk

Perhaps the single most frequently posed question regarding teacher-student relationships regards their potential as a developmental asset, particularly for children likely to struggle in school. Before they walk into school, children with certain behavioral, demographic, academic, and caregiving factors and experiences are at elevated risk for a host of academic and socioemotional difficulties (e.g., Hamre & Pianta, 2005; Henricsson & Rydell, 2004). From an ecologically oriented model, children's relational experience outside of school can be a source of risk, and their relational experiences with teachers in school could theoretically reduce or exacerbate those risks (Bronfenbrenner & Morris, 1998; Ladd, 1996). Children experiencing close relationships with teachers tend to have higher academic performance, lower externalizing behaviors, and better social skills (Crosnoe, Johnson, & Elder, 2004; Ladd & Burgess, 2001; Pianta & Stuhlman, 2004), and there is some evidence that those effects may be greater in children with prior risks. In contrast, low-quality or insecure relationships with teachers may exacerbate the effects of prior risk. Examining the extent to which high-quality teacher-child relationships protect or promote functioning for at-risk children, as well as examine the exacerbating effects of negative relationship quality, will advance the field's understanding about whether relationships with teachers alter developmental trajectories for the most vulnerable children, including children with adjustment problems, and academic risk, and children who experienced poor caregiving environments, and children with demographic risk (Luthar, Cicchetti, & Becker, 2000).

Adjustment Problems

Recognizing that adjustment problems in and out of school are a significant risk factor for later maladjustment, including academic failure, decreased motivation, antisocial behavior, and delinquency (Baker, 1999; Loeber, 1990), there has been an increased focus on protective factors that may alter this developmental trajectory. Importantly, high-quality relationships with teachers appear to decelerate the deleterious effects of risk and promote healthy functioning for children with externalizing and internalizing problems (Baker, 2006; Baker, Grant, & Morlock, 2008; Ladd & Burgess, 2001; Silver, Measelle, Essex, & Armstrong, 2005). For children with *internalizing problems*, teacher-perceived closeness is associated with improved social skills (Berry & O'Connor, 2010), peer relations (Gazelle, 2006), and academic outcomes (Baker, 2006). For instance, Gazelle (2006) found that among children with anxious solitude, an internalizing-type behavior problem, those in early childhood classrooms with observed high levels of emotional support were associated with higher acceptance (boys) and less victimization by peers (girls) compared to children in negative climate classrooms. They did not account for nesting because there was typically only one child per classroom. Although high quality relationships appear to have a protective relation, children with internalizing problems and conflictual relationships are associated with increased depressive symptoms, victimization, peer rejection, and poorer school adjustment (e.g. Silver et al., 2005). Baker, Grant, and Morlock (2008) found among predominately African-American kindergarten through fifth-grade students with internalizing problems, those with high degrees of conflict with their teachers showed poorer school adjustment than similarly affected peers with low levels of conflict.

Children with externalizing problems, in general, are more likely to have conflict with teachers, potentially resulting in a cascade of problematic interactions with others. For instance, externalizing behaviors may result in conflict with the teacher, which may exacerbate children's externalizing behaviors, which then may sustain or increase the negative interactions with the teacher. Doumen and colleagues (2008) found evidence for this transactional cycle in early childhood based on teacher-report of relationships and behavior. Aggressive behavior at the beginning of the preschool year was related to increased conflict with teachers during the year, and increased aggressive behavior by the end of the year.

Although children with adjustment problems are at risk for developing conflictual relationships with teachers (e.g. Decker, Dona, & Christenson, 2007), students with adjustment problems can and do develop positive relationship with teachers (Myers & Pianta, 2008). In general, children with externalizing problems seem to benefit, more than is typical, from a warm, supportive relationship with a teacher in early childhood and elementary school (e.g. Hamre & Pianta, 2005; Meehan et al., 2003). This benefit is also corroborated in parent-child relationship literature that finds parental warmth stabilizes behavior problems, and is associated with a reduction in the growth of externalizing behaviors (e.g. Eisenberg et al., 2005). Children with externalizing problems and positive relationships with teachers also demonstrate higher reading scores (Baker et al., 2008), deceleration of externalizing behaviors (Silver et al., 2005), and higher academic performance (Baker, 2006) compared to children with externalizing problems with less close or conflictual relationships.

Teacher-child relationships consistently emerge a protective factor for externalizing behaviors; however, importantly, the vast majority of work just summarized often used teacher-reports for both predictors and outcomes. One exception is a study of Meehan, Hughes, and Cavell (2003), which after accounting for the clustering of children within classrooms, found that above and beyond teacher reported second grade aggressive behaviors, third grade teacher-reported support predicted lower levels of third grade teacher reported aggression, but did not predict *peer*-reported aggression, suggesting a potential source effect. Importantly, these results to do not mitigate the compelling results using teacher-report that high-quality teacher-child relationships appear to protect against the known effects of behavioral risk, but highlight the need for multiple sources in order to understand the robustness of findings.

Academic Problems

The evidence is a bit more mixed for teacher-child relationships acting as a protective factor for children with risks due to academic problems, perhaps in part due to the dearth of recent research in this area. Children with "academic risk" do tend to develop poorer relationships with their teachers compared to more academically competent children whereas positive relationships with teachers appear to be particularly important for children who struggle with academic demands in school (Eisenhower, Baker, & Blacher, 2007). Teacher-child relationships appear to promote healthy behavioral outcomes and reduce levels of delinquency and socioemotional problems among children with learning difficulties (Al-Yagon & Mikulincer, 2004; Murray & Greenberg, 2001; Pianta, Steinberg, & Rollins, 1995). For instance, among Israeli elementary school students, Al-Yagon and Mikulincer (2004) found beneficial effects of close relationships with teachers for children with learning problems; students who reported closer relationships with teachers had lower levels of loneliness, and student-reported and teacher-reported closeness contributed to students' sense of confidence; however, this study did not account for the nesting of children with classrooms. In terms of academic outcomes, there is no consistent evidence that relationships are able to directly protect against academic underperformance or failure (Baker, 2006; Murray & Greenberg, 2001), which is not completely surprising given that early performance is one of the most salient predictors of subsequent performance (Duncan et al., 2007).

Difficult Parenting Experiences

Components of parenting, such as certain discipline styles or beliefs about child-rearing practices, place children at risk for maladaptive development (Bailey, Hill, Oesterle, & Hawkins, 2009). Relationships with teachers have the opportunity to promote the reorganization of relational schema and buffer the children from negative developmental outcomes associated with problematic early caregiving experiences (e.g., Zajac & Kobak, 2006). Indeed, there is some evidence that children with insecure attachment are able to form positive relationships with teachers, and this positive relationship in turn promotes positive developmental change in other domains (Buyse et al., 2009; Copeland-Mitchell, Denham, & DeMulder, 1997). For instance, Burchinal et al. (2002) conducted an investigation of children in child-care centers across four states from preschool to second grade. After accounting for the nesting of children within classrooms, among children who had parents with more authoritarian parenting practices, children with closer relationships with teachers, as reported by the teacher, exhibited significantly more gains in reading scores compared to children without close relationships. Interestingly, this moderating effect of teacher-child relationships does not appear among aggressive children with poor parenting practices, indicating that the combination of adjustment problems and parental risk may be particularly resistant to protective influences.

Social, Economic, and Cultural Status

Children from various social, economic, and cultural groups, who often demonstrate a higher level of problem outcomes in school, also appear to be protected by high-quality relationships with teachers (e.g., Hamre & Pianta, 2005; Meehan et al., 2003). In general, racial/ethnic minority children (African American and Hispanic) appear to benefit more from close relationships than Caucasian children (Meehan et al., 2003). Burchinal et al. (2002) found that minority children's relationships with teachers strongly predicted their receptive language scores from preschool through second grade, and this moderating relation was sustained even when minority children were reported to have elevated levels of problem behavior. It should be noted that researchers did not test for differences between minority children (i.e., African-American and Hispanic children), which is a limitation considering that African-American children tend to have less supportive relationships with teachers compared to Hispanic and Caucasian children (Hughes & Kwok, 2007).

Hamre and Pianta (2005) examined the extent to which children from families with higher (mothers with a college degree) and lower (mothers with less than a college degree) levels of educational attainment benefitted differentially from teacher-child interactions of varying quality. For children from families with lower levels of educational attainment, exposure to teacher-child interactions consistent with high levels of emotional engagement and language stimulation, gains in literacy skills were equivalent to children from families with higher levels of attainment.

The extant research demonstrates clear evidence for compensatory relation with teacher-child relationships for at-risk children. Studies from the previous decade have begun to uncover how relationships with teachers are related to development, and are better able to account for the nesting of children within classrooms in order to better understand the extent to which teacher-child relationships act as a moderator for at-risk children. Consistent with attachment theories, it appears that having a positive relationship with an adult outside the home, specifically a teacher, can help to reorganize relational models and promote outcomes for at-risk children; however, it remains an important question in how these new relational models are formed.

Training Teachers From a Relational Perspective

Fundamental to any adult-child interaction is the capacity of an adult to accurately read a child's social and emotional cues, respond to a child's signals appropriately, and offer emotional support or limits when needed (Pianta et al., 2003). Therefore, at the most basic level, the quality of these relationships is contingent on adults' individual characteristics and interpersonal skills. Of particular interest are teachers' characteristics that can be changed and altered to increase the quality of relationships with children and ultimately promote positive outcomes for children. Conceptualizing the role of teachers as a central agent of change for improving relationships in the classroom provides the opportunity for intervention, training, and professional development (Goodlad, 1991). The following section examines the extent to which teacher-focused interventions improve relationships within the classroom. Additionally, we supplement the work on interventions for improving teacher-child *relationships* to interventions targeting improvement in teacher-child *interactions* within the classroom.

Historically, both inservice and preservice teacher training have been disjointed and unsystematic, often yielding small effects on improving teacher quality (Ball & Cohen, 1999; Birman, Desimone, Porter, & Garet, 2000; Haymore-Sandholtz, 2002; Pianta, Mashburn, Downer, Hamre, & Justice, 2008). Because of the strong evidence that positive teacher-child relationships matter, and may even promote outcomes for the riskiest children, program developers and policy makers have begun implementing programs specifically designed to alter relationship quality through more direct actions related to knowledge or behavioral change, often called process-oriented professional development (Sheridan, Edwards, Marvin, & Knoche, 2009). Rather than providing teachers with general knowledge unconnected to teachers' classrooms, process inputs focus on providing teachers knowledge, skills, and support within individual classroom contexts and experiences in order to change teaching practices. In this section, we focus on process-oriented professional development that has the explicit intention of improving relationships and interactions between teachers and children.

Until recently, very little empirical work examined the extent to which targeted relational professional development improves teacher-child relationships. However, within the past decade, researchers have begun to implement relationship-focused professional development interventions. This intervention work has strong roots in an attachment framework and often takes into account the dynamic bidirectional influence on relational processes. For example, Driscoll and Pianta (2010) evaluated the effects of an intervention, Banking Time, on improving teacher-child relationships. In Banking Time, a set of one-on-one child-directed sessions occurs between the teacher and child that are specifically designed to foster positive teacher-child relationships. Results indicated that teachers randomly assigned to the Banking Time intervention reported increased perceptions of closeness with children. Additionally, children who participated in Banking Time demonstrated gains in teacher-reported task orientation and competence, and decreased teacher-reported adjustment problems compared to peers in the same classroom who did not participate in the intervention. Children with less close relationships appeared to particularly benefit from teachers receiving Banking Time. One limitation to this work is that both closeness and child outcomes were based on teacher-reports and the lack of outside reporters may have resulted in a source effect.

In addition, there is evidence that professional development can improve *observed* interactions in the classroom. Lyon and colleagues (2009) investigated the effects of Teacher-Child Interaction Training for improving positive interactions in preschool classrooms. Teacher-Child Interaction Training provides group training and practice for interacting with groups of children. Teachers are observed and coaches provide feedback on their classroom practices. Nonexperimental results indicated a mean level change, as well a difference in slope, in positive interactions between teachers and children. In terms of causal evidence, Pianta, Mashburn, Downer, Hamre, and Justice (2008) designed and implemented a random control trial of a web-based system of professional development, MyTeachingPartner (MTP) with a central focus on supporting teachers' representations and beliefs about the importance of interactions in preschool classrooms. The control group was provided with online access to the MTP website, including video examples of high quality interactions and access to web training on Banking Time. The treatment group received consultant support in addition to the online support. Through the consultant support, teachers videotaped their interactions in the classroom and then consultants guided teachers through a reflection on their teaching practices. By the end of the year, prekindergarten teachers in the treatment group who worked with a consultant and had website access had higher observed quality of social and instructional interactions with children than teachers who only had website access (Pianta et al., 2008).

Expanding upon the MTP model, a recent professional development study conducted by the National Center for Research on Early Childhood Education (NCRECE) examined the impact of a skill-focused course that focused on how interactions in early education settings influence children's learning and language outcomes. Teachers who were randomly assigned to participate in the course were better able to accurately report on observed quality teacher-child interactions as well as improve their actual interactions with children compared to teachers who were not in the course (Hamre et al., 2010). Results from MTP, NCRECE and Banking Time interventions suggest that relational-focused, individualized professional development supports for teachers can improve the quality of interactions with children.

Importantly, improving teachers' behaviors and perceptions through a relational lens has shown to be effective in improving children's outcomes. For instance, Murray and Malmgren (2005) evaluated the effects of a randomized control trial on a teacher-student relationship program among students in a high poverty urban school. Teachers were trained to increase their positive interactions with students, held weekly meetings with students, and called home to parents. After excluding grades given by teachers participating in the intervention, students in the intervention had higher grade point averages compared to students in the control group. The intervention did not seem to impact students' socioemotional adjustment. Webster-Stratton, Reid, and Hammond (2004) conducted a randomized control trial on an intervention aimed to improve parents' and teachers' relationships with children with early-onset conduct problems. In the intervention the teacher-training component—which not only addressed classroom management strategies, but also how to promote positive relationships with children with behavior problems—was coupled with a parent-training component. The dual intervention resulted in fewer conduct problems with mothers, teachers, and peers. Importantly, because of the simultaneous intervention on parents and teachers, it is difficult to parse out the unique influence of teacher training.

In addition to training teachers, there is some evidence that indicates interventions targeting personnel other than teachers have positive results. For instance, the school-based Check and Connect program was developed for elementary and middle school students who were at risk for dropping out of school. The Check and Connect program aimed to improve engagement in school through promoting students' relationships with an interventionist/adult figure within the school setting (Anderson, Christenson, Sinclair, & Lehr, 2004). The interventionist conducted ongoing evaluations of students' engagement and ensured that the students received persistent and continuous positive support. Although this study did not have a control group, results suggest that forming a positive adult relationship in school can promote children's development. Interventionists' perceived closeness with students was associated with increased student academic engagement, and improved school attendance.

In terms of preservice training, there are few interventions that focus on modifying existing training in order to improve teachers' ability to form close relationships with children. Some preliminary evidence suggests that preservice training may be a prime target for informing teachers on practices associated with high quality relationships. Rimm-Kauffman, Voorhees, Snell, and La Paro (2003) developed an intervention for master's students in an early childhood special education program. The main components of the intervention were reviewing literature on teacher-child interactions, observing and discussing videotapes of teacher practices, and discussing issues related to teacher sensitivity. In the pilot study, master's level students were able to recognize their sensitive behaviors and identify the ways in which their interactions differed based on child characteristics. Although this study was relatively small scale, it suggests that there may be potential to train teachers on relational practices before they entire the teaching profession.

Overall, teacher-child relationships have begun to emerge as a central agent of change for improving the quality of education, demonstrating promising evidence that focusing on relationships in the classroom can improve children's functioning and adjustment. More specifically, evidence suggests that focusing on providing coherent and cohesive professional development may significantly improve the quality of teacher-child relationships (e.g., Anderson et al., 2004; Bierman et al., 2008; Noam & Fiore, 2004; Pianta et al., 2008). Although most of the work to date exploring the effect of professional development on the quality of relationships, and in turn, children's development and learning, has been limited to controlled empirical investigations, this area of research shows promising results and supports the need for applications to a policy context.

CONCLUSIONS AND FUTURE DIRECTIONS

The past decade has made significant progress towards understanding teacher-child relationships through a developmental systems perspective. This paper reviewed the areas of recommended areas of research set forth by Pianta et al. (2003) in an effort to consolidate and update the current understanding of teacher-child relationships and continue the momentum in exploring teacher-child relationships. Aligned to Pianta et al.'s (2003) suggested research areas, a review of recent empirically rigorous work suggests a number of conclusions regarding four of the five research areas.

First, it appears that children's relationships with teachers in early childhood are associated with attachment patterns with parents, but also with concurrent teacher characteristics. The influence of maternal attachment on teacher-child relationships becomes increasingly complex as children develop, which is most likely due to a host of additional factors including the influence of the quality of teacher-child relationships, the shifting role of teachers, and different informants on relationship quality across schooling. We know little about associations between and among relationships with adults (e.g., parents, coaches, teachers) as children reach adolescence. This seems an important focus for further work.

In terms of the moderating effect of relationship quality, it appears that teacher-child relationships can compensate for the negative effects of earlier experiences. Most strongly supported, close relationships with teachers are associated with improved academic and socioemotional functioning among children with behavioral and demographic risk. Conflictual relationships are associated with exacerbated negative outcomes for children with externalizing and internalizing problems; however, there is less clear evidence on the exacerbating effect for other types of child-level risk. Again, whether and how these moderating influences function for adolescents with regard to contemporary relationships with adults, are open for inquiry and intervention evaluation.

Third, the ability to examine domain-specific associations between teacher-child relationships and different outcomes across schools, is somewhat difficult given the lack of consistent conceptualization and measurement across schools. Thus far, there is some preliminary evidence on the stability of teacher-child relationship constructs, as well as the associations between relational constructs and outcomes within developmental time periods; however, there is a need for longitudinal work across various facets of relational experience (e.g., warmth, conflict, cognitive stimulation) and performance in a variety of outcome domains.

Lastly, recent work on targeted professional development using a relational perspective demonstrates the potential for improving teacher-child relationships. A focus on professional development that provides teachers with knowledge, skills, and support within individual classroom contexts and experiences has been shown to improve the quality of teacher-child relationships and in some cases improve children's outcomes. Although most relationally focused professional development opportunities are typically implemented during inservice, preservice programs may be a particularly important place for relational training.

Across the research areas, there have been significant gains in methodology approaches, conceptualization, and integration across disciplines. The following section highlights areas for future research. The first aim was set forth by Pianta et al. (2003), yet still needs significant advancement. The remaining aims integrate critical areas of research needed to advance research across all lines of inquiry related to teacher-child relationships.

Future Directions

1. As highlighted in Pianta et al. (2003), there is a need to understand the continuity of relationships across contexts or across teachers. Understanding contextual effects on relationships may be particularly important in middle school where students may have multiple teachers in a given year. Additionally, exploring this area would give specific insight into whether children apply their relational schema between home and school settings. The extent to which children's relationships qualify with adults is durable across settings seems particularly important as the field moves forward and researchers unfold the increasingly complex system that influences teacher-child relationships.
2. Understanding the varying role of teachers across children's development is rather difficult because of the lack of consistent constructs across early childhood, elementary school, and middle school. In order to

create a measure across these time periods, researchers would need to strike a balance between creating a time invariant assessment that combines these constructs while designing a developmentally sensitive instrument. Further research is needed to best understand how to conceptualize and measure relationships across development.

3. Further research is needed to better understand whether results hold across different raters of relationships, as well as different raters of behavioral and socioemotional outcomes. For instance, in early childhood, it may be useful to assess teacher- and child-perceptions of closeness, as well as observe relationships between dyads. Some preliminary work in this area demonstrates the potential for multiple perspectives (e.g., Koepke & Harkins, 2008; Mantzicopoulos & Neuharth-Pritchett, 2003), but further research is needed on source effects and the robustness of findings across multiple informants.
4. Although the studies from the previous decade have begun to uncover how relationships with teachers are related to development, past studies tend to be limited by their methods and design, mostly using non-experimental data. Because children are not randomly assigned into classrooms, future studies should use designs to control for the selection of children into certain classrooms.
5. There is a need to expand beyond the dyadic paradigm and intervene across multiple levels within the developmental system, including community, classroom, family, and individual contexts. Clearly delineating and disseminating the school-, classroom-, and individual-level practices and structures associated with closer relationships between teachers and students would aid educators in promoting positive outcomes, particularly for at-risk children, and aid in teacher professional development.
6. The reciprocal interactions between teachers and children are embedded within a complex system including proximal factors such as families and peers, and more distal features such as schools, communities, and cultures (Good & Weinstein, 1986; Pianta, 1999; Pianta et al., 2003). To date, ecological studies have explored how multiple systems interact and influence relationships; however, these studies often omit sociocultural influences. Recent international work suggests that student-teacher relationships may operate differently depending on the cultural context (e.g., Fredriksen & Rhodes, 2004; Joshi, 2009). Thus, it is important to explore the extent to which sociocultural context influences relational quality across settings in the United States.

By and large, the field has made significant progress in understanding the complex role of teacher-child relationships. We need to continue the necessary integration between lines of inquiry in order to further our understanding of the nature and influence of relationships between teachers and children.

REFERENCES

Ahnert, L., Pinquart, M., & Lamb, M. E. (2006). Security of children's relationships with nonparental care providers: A meta-analysis. *Child Development, 77*, 664–679.

Al-Yagon, M., & Mikulincer, M. (2004). Socioemotional and academic adjustment among children with learning disorders: The mediational role of attachment-based factors. *Journal of Special Education, 38*, 111–123.

Anderson, A. R., Christenson, S. L., Sinclair, M. F., & Lehr, C. A. (2004). Check & connect: The importance of relationships for promoting engagement with school. *Journal of School Psychology, 42*, 95–113.

Bailey, J. A., Hill, K. G., Oesterle, S., & Hawkins, J. D. (2009). Parenting practices and problem behavior across three generations: Monitoring, harsh discipline, and drug use in the intergenerational transmission of externalizing behavior. *Developmental Psychology, 45*(5), 1214–1226.

Baker, J. A. (1999). Teacher-student interaction in urban at-risk classrooms: Differential behavior, relationship quality, and student satisfaction with school. *Elementary School Journal, 100*, 57–70.

Baker, J. A. (2006). Contributions of teacher–child relationships to positive school adjustment during elementary school. *Journal of School Psychology, 44*, 211–229.

Baker, J. A., Grant, S., & Morlock, L. (2008). The teacher–student relationship as a developmental context for children with internalizing or externalizing behavior problems. *School Psychology Quarterly, 23*, 3–15.

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3–32). San Francisco, CA: Jossey-Bass.

Barber B. K., & Olsen, J. (2004). Assessing the transitions to middle and high school. *Journal of Adolescent Research, 19*, 3–30.

Berry, D., & O'Connor, E. (2010). Behavioral risk, teacher-child relationships, and social skill development across middle childhood: A child-by-environment analysis of change. *Journal of Applied Developmental Psychology, 31*, 1–14.

Bierman, K. L., Domitrovich, C. E., Nix, R. L., Gest, S. D., Welsh, J. A., Greenberg, M. T., . . . Gill, S. (2008). Promoting academic and social-emotional school readiness: The Head Start REDI program. *Child Development, 179*, 1802–1817.

Birch, S. H., & Ladd, G. W. (1997). The teacher-child relationship and children's early school adjustment. *Journal of School Psychology, 35*, 61–79.

Birman, B. F., Desimone, L., Porter, A. C., & Garet, M. S. (2000). Designing professional development that works. *Educational Leadership, 57*(8), 1–8.

Booth, C. L., Kelly, J. F., Spieker, S. J., & Zuckerman, T. G. (2003). Toddlers' attachment security to child-care providers: The safe and secure sScale. *Early Education and Development, 14*, 83–100.

Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (5th ed., pp. 993–1029). New York, NY: Wiley.

Burchinal, M. R., Peisner-Feinberg, E., Pianta, R., & Howes, C. (2002). Development of academic skills from preschool through second grade: Family and classroom predictors of developmental trajectories. *Journal of School Psychology, 40*, 415–456.

Buyse, E., Verschueren, K., & Doumen, S. (2009, July). Preschoolers' attachment to mother and risk for adjustment problems in kindergarten: Can teachers make a difference? *Social Development*, (1–18). doi: 10.1111/j.1467-9507.2009.00555.x

Buyse, E., Verschueren, K., Doumen, S., Van Damme, J., & Maes, F. (2008). Classroom problem behavior and teacher-child relationships in kindergarten: The moderating role of classroom climate. *Journal of School Psychology, 46*, 367–391.

Carnegie Council on Adolescent Development. (1989). *Turning point: Preparing American youth for the 21st century: The report of the task force on the education of young adolescents*. Washington, DC: Author.

Copeland-Mitchell, J., Denham, S. A., & DeMulder, E. K. (1997). Q-sort assessment of child-teacher attachment relationships and social competence in the preschool. *Early Education and Development, 8*, 27–39.

Cost, Quality, and Child Outcomes Study Team. (1995). *Cost, quality, and child outcomes in child care centers, Public report* (2nd ed.). Denver: Economics Department, University of Colorado at Denver.

Crosnoe, R., Johnson, M. K., & Elder, G. H. (2004). Inter-generational bonding in school: The behavioral and contextual correlates of student–teacher relationships. *Sociology of Education, 77*, 60–81.

Davis, H. A. (2001). The quality and impact of relationships between elementary school students and teachers. *Contemporary Educational Psychology, 26*, 431–453.

Decker, D. M., Dona, D. P., & Christenson, S. L. (2007). Behaviorally at-risk African American students: The importance of student–teacher relationships for student outcomes. *Journal of School Psychology, 45*(1), 83–109.

Doumen, S., Verschueren, K., Buyse, E., Germeijs, V., Luyckx, K., & Soenens, B. (2008). Reciprocal relations between teacher-child conflict and aggressive behavior in kindergarten: A three-wave longitudinal study. *Journal of Clinical Child and Adolescent Psychology, 37*, 588–599.

Driscoll, K. C., & Pianta, R. C. (2010). Banking time in head start: Early efficacy of an intervention designed to promote supportive teacher-child relationships. *Early Education and Development, 21*, 38–64.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., . . . Japel, C.. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428–1446.

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development, 76*, 1055–1071.

Eisenhower, A. S., Baker, B. L., & Blacher, J. (2007). Early student–teacher relationships of children with and without intellectual disability: Contributions of behavioral, social, and self-regulatory competence. *Journal of School Psychology, 45*, 363–383.

Fredriksen, K., & Rhodes, J. (2004). The role of teacher-student relationships in the lives of students. *New Directions for Youth Development, 103*, 45–54.

Furman, W., & Buhrmester, D. (1985). Children's perceptions of the personal relationships in their social networks. *Developmental Psychology, 21*, 1016–1024.

Furrer, C., & Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology, 95*, 148–162.

Gambone, M. A., Klem, A. M., & Connell, J. P. (2002). *Finding out what matters for youth: Testing key links in a community action framework for youth development.* Philadelphia, PA: Youth Development Strategies and Institute for Research and Reform in Education.

Gazelle, H. (2006). Class climate moderates peer relations and emotional adjustment in children with an early history of anxious solitude: A child × environment model. *Developmental Psychology, 42*, 1179–1192.

Good, T. L., & Weinstein, R. S. (1986). Schools make a difference: Evidence, criticisms, and new directions. *American Psychologist, 41*, 1090–1097.

Goodlad, J. (1991). Why we need a complete redesign of teacher education. *Educational Leadership, 49*(3), 4–10.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72*, 625–638.

Hamre, B. K., & Pianta, R. C. (2005). Can instructional and emotional support in the first grade classroom make a difference for children at risk of school failure? *Child Development, 76*, 949–967.

Hamre, B. K., Pianta, R. C., Burchinal, M., Field, S., LoCasale-Crouch, J., & Downer, J. (2010) *A course on supporting early language and literacy development through effective teacher-child interactions: Effects on teacher beliefs, knowledge, and practice.* Unpublished manuscript. Curry School of Education, University of Virginia, Charlottesville, VA.

Haymore-Sandholtz, J. (2002). Inservice training or professional development: Contrasting opportunities in a school/university partnership. *Teaching and Teacher Education, 18*, 815–830.

Henricsson, L., & Rydell, A. (2004). Elementary school children with behavior problems: Teacher–child relations and self-perception. A prospective study. *Merrill-Palmer Quarterly, 50*, 111–138.

Howes, C., Hamilton, C. E., & Matheson, C. C. (1994). Children's relationships with peers: Differential associations with aspects of the teacher-child relationship. *Child Development, 65*, 253–263.

Hughes, J. N., & Kwok, O. (2007). Influence of student–teacher and parent–teacher relationships on lower achieving readers' engagement and achievement in the primary grades. *Journal of Educational Psychology, 99*, 39–51.

Hughes, J. N., Luo, W., Kwok, O. M., & Loyd, L. K. (2008). Teacher-student support, effortful engagement, and achievement: A 3-year longitudinal study. *Journal of Educational Psychology*, *100*(1), 1–14. PMID: 19578558

Joshi, A. (2009). What do teacher-child interactions in early childhood classrooms in India look like? Teachers' and parents' perspectives. *Early Child Development and Care, 1*, 1–19.

Klem, A. M., & Connell, J. P. (2004). Relationships matter: Linking teacher support to student engagement and achievement. *Journal of School Health, 74*, 262–273.

Koepke, M. F., & Harkins, D. A. (2008). Conflict in the classroom: Gender differences in the teacher-child relationship. *Early Education and Development, 19*, 843–864.

Ladd, G. W. (1996). Shifting ecologies during the 5–7 year period: Predicting children's school adjustment during the transition to grade school. In A. Sameroff & M. Haith (Eds.), *Reason and responsibility: The passage through childhood* (pp. 363–386). Chicago, IL: University of Chicago Press.

Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in kindergarten: Related spheres of influence? *Child Development, 70*(6), 1373–400.

Ladd, G. W., & Burgess, K. B. (2001). Do relational risk and protective factors moderate the links between childhood aggression and early psychological and school adjustment? *Child Development, 72*, 1579–1601.

Lerner, R. M. (1998). Theories of human development: Contemporary perspectives. In W. Damon & R. M. Lerner (Eds.), *Handbook of* *child psychology: Vol. 1. Theoretical models of human development* (5th ed., pp. 1–24). New York, NY: Wiley.

Loeber, R. (1990). Developmental and risk factors of juvenile antisocial behavior and delinquency. *Clinical Psychology Review, 10*, 1–42.

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development, 71*, 543–562.

Lynch, M., & Cicchetti, D. (1997). Children's relationships with adults and peers: An examination of elementary and junior high school students. *Journal of School Psychology, 35*, 81–99.

Lyon, A. R., Gershenson, R. A., Farahmand, F. K., Thaxter, P. J., Behling, S., & Budd, K. S. (2009). Effectiveness of teacher-child interaction training (TCIT) in a preschool setting. *Behavior Modification*, *33*, 855–884.

Mantzicopoulos, P., & Neuharth-Pritchett, S. (2003). Development and validation of a measure to assess head start children's appraisals of teacher support. *Journal of School Psychology, 41*, 431–451.

Mashburn, A. J., & Pianta, R. C. (2006) Social Relationships and School Readiness. *Early Education & Development, 17*, 151–176.

Mashburn, A., Pianta, R., Hamre, B., Downer, J., Barbarin, O., Bryant, D., . . . Howes, C. (2008). Measures of classroom quality in pre-kindergarten and children's development of academic, language and social skills. *Child Development, 79*(3), 732–749.

Meehan, B. T., Hughes J. L., & Cavell T. A. (2003). Teacher–child relationships as compensatory resources for aggressive children. *Child Development, 74*, 1145–1157.

Murray, C. (2009). Parent and teacher relationships as predictors of school engagement and functioning among low-income urban youth. *Journal of Early Adolescence, 29*, 376–404. PMID: 10621962

Murray, C., & Greenberg, M. T. (2001). Relationships with teachers and bonds with school: Social emotional adjustment correlates for children with and without disabilities. *Psychology in the Schools, 38*, 25–41.

Murray, C., & Malmgren, K. (2005). Implementing a teacher-student relationship program in a high poverty urban school: Effects on social, emotional, and academic adjustment and lessons learned. *Journal of School Psychology, 43*, 137–152.

Myers, S. S., & Pianta, R. C. (2008). Developmental commentary: Individual and contextual influences on student-teacher relationships and children's early problem behaviors. *Journal of Clinical Child & Adolescent Psychology, 37*, 600–608.

Noam, G., & Fiore, N. (2004). Relationships across multiple settings: An overview. *New Directions for Youth Development, 103*, 9–16.

O'Connor, E., & McCartney, K. (2006). Testing associations between young children's relationships with mothers and teachers. *Journal of Educational Psychology, 98*, 1, 87–98.

O'Connor, E., & McCartney, K. (2007). Examining teacher–child relationships and achievement as part of an ecological model of development. *American Educational Research Journal, 44*, 340–369.

Palermo, F., Hanish, L., Martin. C., Fabes, R., & Reiser, M. (2007). Preschoolers' academic readiness: What role does the teacher–child relationship play? *Early Childhood Research Quarterly, 22*, 407–422.

Pianta, R. C. (1999). *Enhancing relationships between children and teachers*. Washington, DC: American Psychological Association.

Pianta, R. C., Hamre, B. K., & Stuhlman, M. (2003). Relationships between teachers and children. In W. Reynolds, & G. Miller (Eds.), *Educational psychology* (pp. 199–234). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology*. Hoboken, NJ: Wiley.

Pianta, R. C., Mashburn, A. J., Downer, J., Hamre, B. K., & Justice, L. (2008). Effects of web-mediated professional development resources on teacher-child interactions in pre-kindergarten classrooms. *Early Childhood Research Quarterly, 23*, 431–451.

Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2007). *Classroom Assessment Scoring System [CLASS] Manual: Pre-K*. Baltimore, MD: Brookes.

Pianta, R. C., Steinberg, M. S., & Rollins, K. B. (1995). The first two years of school: Teacher-child relationships and deflections in children's classroom adjustment. *Development and Psychopathology, 7*, 295–312.

Pianta, R. C., & Stuhlman, M. W. (2004). Teacher-child relationships and children's success in the first years of school. *School Psychology Review, 33*, 444–458.

Reddy, R., Rhodes, J. E., & Mulhall, P. (2003). The influence of teacher support on student adjustment in the middle school years: A latent growth curve study. *Development and Psychopathology*, *15*, 119–138.

Resnick, M. D., Bearman, P. S., Blum, R. W., Bauman, K., Harris, K. M., Jones, J., . . . Udry, J. R. (1997). Protecting adolescents from harm: Findings from the National Longitudinal Study of Adolescent Health. *Journal of the American Medical Association, 278*, 823–832.

Rimm-Kauffman, S. E., Voorhees, M. D., Snell, M. E., & La Paro, K. M. (2003). Improving the sensitivity and responsivity of preservice teachers toward young children with disabilities. *Topics in Early Childhood Special Education, 23*, 151–163.

Roeser, R. W., & Galloway, M. G. (2002). Studying motivation to learn in early adolescence: A holistic perspective. In F. Pajares & T. Urdan (Eds.), *Academic motivation of adolescents: Adolescence and Education* (Vol. 2, pp. 331–372). Greenwich, CT: Information Age.

Rydell, A. M., Bohlin, G., & Thorell, L. B. (2005). Representations of attachment to parents and shyness as predictors of children's relationships with teachers and peer competence in preschool. *Attachment and Human Development, 7*, 187–204.

Saft, E. W., & Pianta, R. C. (2001). Teachers' perceptions of their relationships with students: Effects of child age, gender, and ethnicity of teachers and children. *School Psychology Quarterly, 16*, 125–141.

Sameroff, A. J. (1995). General systems theories and psychopathology. In D. Cicchetti & D. Cohen (Eds.), *Developmental psychopathology* (Vol. 1). New York, NY: Wiley.

Sheridan, S. M., Edwards, C. P. Marvin, C. A., &. Knoche, L. L. (2009). Professional development in early childhood programs: Process issues and research needs. *Early Education & Development, 20*, 377–401.

Silver, R. B., Measelle, J., Essex, M., & Armstrong, J. M. (2005). Trajectories of externalizing behavior problems in the classroom: Contributions of child characteristics, family characteristics, and the teacher-child relationship during the school transition. *Journal of School Psychology, 43*, 39–60.

Sroufe, L. A. (1989). Relationships, self, and individual adaptation. In A. J. Sameroff & R. N. Emde (Eds.), *Relationship disturbances in early childhood. A developmental approach* (pp. 70–93). New York, NY: Basic Books.

Webster-Stratton, C., Reid, M. J., & Hammond, M. (2004). Treating children with early-conduct problems: Intervention outcomes for parent, child, and teacher training. *Journal of Clinical Child and Adolescent Psychology, 33*, 105–124.

Zajac, K., & Kobak, R. (2006). Attachment. In G. G. Bear & K. M. Minke (Eds.), *Children's needs III: Development, prevention and intervention* (pp. 379–389). Washington, DC: National Association of School Psychologists.

CHAPTER 10

School Adjustment

KATHRYN R. WENTZEL

SCHOOL ADJUSTMENT

Being successful at school requires children to perform a range of social as well as academic competencies. In addition to mastering subject matter, developing effective learning strategies, and performing well on tests, children also work to maintain and establish interpersonal relationships, strive to develop social identities and a sense of belongingness, observe and model standards for performance displayed by others, and are rewarded for behaving in ways that are valued by teachers and peers. Quite often, children who succeed in these social endeavors are also the most academically successful students. Although these activities might vary somewhat as a function of a child's age or the subject being taught, they reflect the fact that positive forms of social behavior can create a classroom environment that is conducive to learning and cognitive development; similarly, positive interpersonal relationships with teachers and peers can motivate and support the development of intellectual competencies.

In this chapter, children's adjustment to school is discussed with respect to those social competencies that facilitate achievement of school-related objectives. Specifically, the focus is on school adjustment as defined by social engagement, in the form of social goal pursuit, behavioral competence, and positive interpersonal relationships. Research on each aspect of social engagement is reviewed, with particular attention to how it forms a profile of competencies that are related to each other as well as to academic achievement. In addition, research on social processes that promote academic motivation and performance at school is reviewed. The implications of this literature for future work on school adjustment is discussed.

DEFINING SCHOOL ADJUSTMENT

School adjustment is often used as a generic term that refers to any school-related outcome under investigation. However, researchers focus their attention most often on the degree to which students engage in or refrain from negative behavior such as aggression, inattention, or class disruption, rather than examining desirable aspects of engagement such as cooperative, compliant, or self-regulated behavior. To guide the present discussion, therefore, an ecological, competence-based approach is utilized, in which adjustment is defined as engaging in positive forms of social behavior that result in social integration and in positive developmental outcomes for the self. Socially integrative outcomes are those that promote the smooth functioning of the social group or that reflect positive recognition in the form of social approval and acceptance, whereas self-related outcomes are those reflecting the achievement of personal competence, feelings of self-determination, and feelings of social and emotional well-being (Bronfenbrenner, 1989; Ford, 1992). This definition implies that adjustment is a highly context-specific outcome reflecting the degree to which students are able to meet the demands of the classroom environment as well as achieve their own personal goals.

Several perspectives on the nature of competence provide support for this approach. Bronfenbrenner (1989) argues that competence can only be understood in terms of context-specific effectiveness, as reflected in mastery of culturally and socially defined tasks. Therefore, competence is not only a product of personal attributes such as goals, values, self-regulatory skills, and cognitive abilities, but of ways in which these attributes contribute to meeting situational requirements and demands. From this description it follows that social competence is achieved to the extent that students accomplish goals that have personal as well as social value in a manner that supports continued psychological and emotional well-being.

In the social developmental literature, the psychological underpinnings of these competencies include knowledge of effective behavioral repertoires, social problem-solving skills, positive beliefs about the self, achievement of social goals, and positive interpersonal relationships (see Rose-Krasnor, 1997). In addition, however, an ecological perspective posits that the ability to be socially competent also is contingent on opportunities and affordances of the social environment that allow individuals to pursue personally valued and socially relevant goals. Indeed, Bronfenbrenner argues that competence is achieved in part, when contexts provide opportunities for the growth and development of personal attributes as well as scaffolding for learning what is expected by the social group.

Expanding on this notion of situated competence, Ford (1992) argued that several contextual supports can promote positive social engagement, including information concerning what is expected and valued; help and instruction such that attempts to achieve these valued outcomes are met; a safe, nonthreatening environment; and emotional involvement such that individuals are made to feel like a valued member of the group. Applying Ford's dimensions of supportive contexts specifically to classroom and school settings, this perspective implies that students will engage in the pursuit of adaptive goals in part, when their teachers and peers communicate expectations and standards for achieving multiple goals; provide direct assistance and help in achieving them; and create a climate of emotional support, including protection from physical threats and harm.

In essence, therefore, a full appreciation of how and why students thrive or fail to thrive at school requires an understanding of a student's personal interests and goals, as well as the degree to which these are valued by teachers and peers, and contribute to the stability and smooth functioning of the classroom. Implicit in this perspective is that personal attributes such as the ability to coordinate multiple goals, motivation to behave in prosocial and responsible ways, and concomitant social-cognitive skills make critical contributions to school adjustment. In addition, the "developmentally-instigating" properties (Bronfenbrenner, 1989) of the classroom that support and promote the expression and development of these personal attributes as well as goal attainment must also be in place.

Based on this definition, research on student adjustment as defined by social goal pursuit, behavioral competence, and relationships with teachers and peers will be the focus of discussion in this chapter. Ways in which contextual supports at school might support these aspects of adjustment also are discussed.

RESEARCH ON SOCIAL ASPECTS OF SCHOOL ADJUSTMENT

Interest in social aspects of school adjustment has increased over the past decade, especially with regard to the role of social motivation, behavioral competence, and interpersonal relationships in promoting academic success (e.g., Juvonen, 2006; Sanna, Simone, & Hanna, 2010; Wentzel, 2009; Wentzel & Looney, 2007). In this section, research on social goal pursuit, positive aspects of classroom behavior, and teacher-student and peer relationships are reviewed.

Social Goal Pursuit

A basic tenet of motivational theories is that people set goals for themselves and that these goals can be powerful motivators of behavior (Austin & Vancouver, 1996; Bandura, 1986; Dweck, 1991). Although definitions vary slightly as a function of theoretical perspective, goals are generally referred to as cognitive representations of desired future outcomes. Research on classroom motivation is typically focused on task-related and cognitive goals. However, the pursuit of socially integrative goals such as to be cooperative and compliant or to establish interpersonal relationships is equally important for understanding school success. Researchers have studied social goals from three fairly distinct perspectives (see Wentzel, 2002a). First, researchers have investigated children's knowledge about and choice of social goals as a social cognitive skill. Based on models of social information processing (e.g., Crick & Dodge, 1994; Dodge, 1986; Ford, 1984), this perspective highlights children's interpretations of social situations and their knowledge of which goals are appropriate or inappropriate to pursue under various conditions. Second, social goals have been construed as motivational or personality orientations that guide children's behavioral responses to social opportunities and challenges (Dweck & Leggett, 1988; McClelland, 1987). For the most part, these more global social goals or needs are believed to function independently of context.

Finally, the pursuit of social goals has been studied as a motivational process that provides direction to behavior and is related to situation-specific competence. From this perspective, goals are defined with respect to their content, that is, as a cognitive representation of *what* it is that an individual is trying to achieve in a given situation (see also Ford, 1992; Wentzel, 2000b). Examples of school-related goals are social relationship goals such as to gain approval from others, to establish personal relationships with teachers or peers, or to cooperate with classmates; task-related goals such as to master subject matter or to meet as a specific standard of achievement; or more cognitive goals such as to engage in creative thinking or to satisfy intellectual curiosity or challenge (see Ford, 1992, for a comprehensive list of goals). This latter perspective is the focus of the present discussion. In the following section, research on specific goals that are promoted within educational contexts is described.

Goals for Education

Public schools were initially developed with an explicit function of educating children to become healthy, moral, and economically productive citizens. Since then, social outcomes in the form of moral character, conformity to social rules and norms, cooperation, and positive styles of social interaction have been promoted consistently as goals for students to achieve (see Wentzel, 1991c, for a review). Given these overarching social goals for education, are there specific goals that are valued more than others in school settings? Do teachers and peers have goals for students concerning what they value and believe should be accomplished within the classroom, and do these goals correspond to goals that students typically espouse for themselves?

Teachers' Goals for Students

Researchers rarely have asked teachers about their specific goals for students. In preschool and child-care settings, researchers typically identify desirable outcomes of care such that the focus of empirical investigations has been on outcomes that reflect developmentally appropriate milestones for young children, such as secure attachments to teachers and cooperative interactions with peers (Shonkoff & Phillips, 2000), rather than on identifying specific goals that teachers would like children to achieve. In studies of older children, researchers typically ask teachers what they think well-adjusted and successful students are like. Elementary-school teachers report preferences for students who are cooperative, conforming, cautious, and responsible rather than independent, assertive, argumentative or disruptive (e.g., Brophy & Good, 1974). Similarly, in the middle-school grades, teachers describe their "ideal" students as sharing, helpful, and responsive to rules, as persistent, and intrinsically interested, and as earning high grades (Wentzel, 2003).

Researchers also have documented social values and expectations that teachers communicate to their students, including appropriate ways to respond to requests, appropriate contexts for different types of behavior, and expectations for impulse control, mature problem solving, and involvement in class activities (e.g., Shultz & Florio, 1979; Trenholm & Rose, 1981). Teachers also communicate expectations for students' interactions with each other. Preschool teachers tend to focus on the development of prosocial behavior by modeling and encouraging prosocial interactions, discouraging social exclusion, and creating cooperative activities (e.g., Doescher & Sugawara, 1989; Hagens, 1997). Elementary and secondary teachers focus on establishing norms for sharing, working well with others, and adherence to rules concerning aggression, manners, stealing, and loyalty (Hargreaves, Hester, & Mellor, 1975; Sieber, 1979).

Students' Goals for Each Other

The classroom goals that students would like each other to achieve also are not well documented. However, it is reasonable to assume that students also communicate to each other expectations concerning valued forms of behavior. For instance, approximately 70% of adolescents from three predominantly middle-class middle schools reported that their peers expected them to be cooperative and helpful in class either sometimes or always, and approximately 80% reported similar levels of peer expectations for academic learning (Wentzel, Battle, Russell, & Looney, 2010). Therefore, at least in some schools, peers actively promote the pursuit of positive social and academic outcomes. However, as students advance through their middle school and high school years, the degree to which their goals and values support adult-valued academic accomplishments can become fairly attenuated. In samples of high school students, only 40% of adolescents report similar levels of peer academic expectations (Wentzel, Monzo, Williams, & Tomback, 2007).

In addition to general expectations concerning socially desirable outcomes, peers also provide proximal input concerning reasons for engaging in academic tasks. In support of this notion, students who perceive relatively high expectations for academic learning and engagement from their peers also report that they pursue goals to learn for intrinsic or internalized reasons (e.g., because it is important or fun; Wentzel, 2004). In the social domain, perceived expectations from peers for behaving prosocially also are significant predictors of internalized values for and displays of prosocial behavior (Wentzel et al., 2007). Therefore, students who see that their peers value and enjoy engaging in specific academic tasks and social interactions are likely to lead to similar positive opinions and attitudes about those same tasks (Bandura, 1986).

Student's Goals for Themselves

Finally, research on students' social goals also has not been frequent. However, adolescent students consistently express interest in forming positive relationships with their classmates, including having fun and making friends (Allen, 1986; A. M. Ryan & Shim, 2008; Wentzel, 1989, 1991b). Establishing positive relationships with teachers is also of concern to most students. However, clear developmental trends are evident. Whereas elementary-school aged children often describe teachers as being important sources of support (Reid, Landesman, Treder, & Jaccard, 1989), adolescents rarely mention relationships with teachers as having importance in their lives (Lempers & Clark-Lempers, 1992). Finally, when asked to endorse social and academic goals to pursue at school, adolescent students typically indicate frequent attempts to achieve a range of social behavioral goals, including being dependable and responsible (e.g., following classroom rules, keeping promises with peers), and being helpful and cooperative (e.g., sharing information and resources, helping classmates with problems) (Wentzel, 1989).

Relations of Goal Pursuit to Other Aspects of Social Engagement and Achievement

Of relevance for understanding school adjustment from an ecological perspective is whether pursuit of these goals is related to other aspects of social engagement as well as to academic performance. In general, the literature suggests this is so. For example, pursuit of goals to be prosocial and socially responsible has been related consistently and positively to displays of prosocial and responsible behavior (Wentzel, 1991a, 1994; Wentzel et al., 2007). Similarly, pursuit of these same goals has been related positively to social acceptance by teachers as well as by peers (Wentzel, 1991a, 1991b, 1994). For example, Wentzel's work in this area has documented significant, positive relations between middle school students = pursuit of goals to be prosocial and socially responsible and perceptions that their relationships with teachers are emotionally supportive (e.g., Wentzel, 1994, 1997, 1998, 2002b). Moreover, there is ample evidence that pursuit of goals to be prosocial and socially responsible is related to classroom grades as well as IQ (Wentzel, 1989, 1991a, 1993a, 1996, 1997, 1998). Of particular relevance for the current discussion, therefore, is that these findings provide support for the notion that social goal pursuit represents a basic psychological process underlying social behavior and interpersonal competence.

Behavioral Competence: Prosocial and Socially Responsible Behavior

As a direct outcome of social goal pursuit, the importance of behavioral competence for understanding students' success at school is clear. Behavioral competence has been studied most often with respect to adherence to social rules and expectations reflecting cooperation, respect for others, and positive forms of group participation that govern social interaction in the classroom. Most generally, positive aspects of behavioral outcomes are studied in terms of prosocial and responsible behavior, with behavioral incompetence taking the form of aggressive and antisocial behavior (Wentzel, 1991c).

Of interest for the present discussion is that these social competencies appear to contribute to academic accomplishments at school. For example, correlational studies indicate that tendencies to be prosocial and empathic, prosocial interactions with peers, appropriate classroom conduct, and compliance have been related positively to intellectual outcomes in the elementary years (see Wentzel, 1991c, for a review). Young adolescents' prosocial behavior also has been related positively to classroom grades and standardized test scores (Wentzel, 1991a, 1993b). Longitudinal studies also have linked behavioral competence to classroom grades and test scores, often after taking into account IQ, sex, grade level, and other demographic factors (e.g., Feldhusen, Thurston, & Benning, 1970; Lambert, 1972; Safer, 1986). Based on a comprehensive review of both follow-up and follow-back studies, Parker and Asher (1987) concluded that antisocial and aggressive behavior in the early grades places children at risk for dropping out of high school. Finally, interventions that teach children appropriate social responses to instruction, such as paying attention and volunteering answers have led to significant and stable gains in academic achievement (Cobb & Hopps, 1973; Hopps & Cobb, 1974).

Behaving in prosocial and responsible ways also has been related to positive relationships with teachers and peers. Indeed, teachers' preferences for students are based in large part on students' social behavior in the classroom (e.g., Brophy & Good, 1974; Wentzel, 2000a). Likewise, students who are socially accepted by their peers tend to be highly cooperative, helpful, sociable, and self-assertive, whereas socially rejected students are less compliant, less self-assured, less sociable and more aggressive, disruptive, and withdrawn than many of their classmates (Rubin, Bukowski, & Parker, 1998). Similarly, children with friends at school tend to be more sociable, cooperative, prosocial, and emotionally supportive when compared to their classmates without friends (Newcomb & Bagwell, 1995; Wentzel, Barry, & Caldwell, 2004). This literature on interpersonal relationships is described in greater depth in the following section.

Interpersonal Relationships With Peers and Teachers

Interpersonal relationships are typically defined as enduring connections between two individuals, uniquely characterized by degrees of continuity, shared history, and interdependent interactions across settings and activities (Collins & Repinski, 1994; Hinde, 1997). In addition, definitions are frequently extended to include the qualities of a relationship, as evidenced by levels of trust, intimacy, and sharing; the presence of positive affect, closeness, and affective tone; and the content and quality of communication (Collins & Repinski; Laible & Thompson, 2007). As with behavioral competence, positive interpersonal relationships are valued outcomes in and of themselves. They also are necessary for successful group functioning. Therefore, interpersonal relationships with teachers and peers as positive aspects of social engagement at school are discussed next.

Relationships With Teachers

Evidence to support the importance of teacher-student relationships in students' lives has increased tremendously in the past 10 years. Research has focused primarily on the affective qualities of these relationships, and the extent to which they are emotionally supportive for students (see Wentzel, 2009, for a review).

In kindergarten, teacher-student relationships marked by emotional closeness have been related positively to academic functioning, school liking, socially competent and self-directed behavior, and negatively to aggressive behavior and peer rejection (e.g., Birch & Ladd, 1997, Ladd & Burgess, 2001; Silver, Measelle, Armstrong, & Essex, 2005). In contrast, relationships marked by conflict have been related positively to children's aggressive and socially incompetent behavior and peer rejection (e.g., Birch & Ladd; Ladd & Burgess), and negatively to school-liking, self-directed behavior (Birch & Ladd), academic grades, and test scores (Hamre & Pianta, 2001). Longitudinal studies have documented that qualities of teacher-student relationships in kindergarten predict similar social-emotional outcomes in first and second grade (e.g., Peisner-Feinberg et al., 2001; Pianta & Stuhlman, 2004; Silver et al.). Significant relations with academic outcomes also have been reported (Hamre & Pianta; Peisner-Feinberg et al.) but not as consistently (cf., Pianta & Stuhlman). Following children from kindergarten through eighth grade, Hamre and Pianta (2001) found kindergartners' relationships with teachers marked by conflict and dependency predicted not only lower grades and standardized test scores, but fewer positive work-habits and increased numbers of disciplinary infractions through eighth grade, especially for boys.

Attachment theory (Bowlby, 1969; Bretherton, 1987) and self-determination theory (R. M. Ryan & Deci, 2000) both predict that the affective quality of teacher-student relationships also should be related to students' sense of self and emotional well-being. Although rarely the focus of research on young children, in late elementary school, students' reports of negative relationships with teachers also have been related to anxiety and depression (Murray & Greenberg, 2000); secure relationships with teachers have been related to students' identification with teachers' values and positive social self-concept (Davis, 2001). During the middle-school years, perceiving positive support from teachers also has been related to emotional well-being (Wentzel, 1997, 1998), whereas a lack of perceived support has been related to internalizing problems such as depression and emotional distress (e.g., Mitchell-Copeland, Denham, & DeMulder, 1997; Wentzel, 1997). In middle-school samples, the affective quality of relationships with teachers also has been related to a range of self-processes including perceived autonomy, perceived control, and self-esteem (R. M. Ryan, Stiller, & Lynch, 1994; Zimmer-Gembeck & Locke, 2007).

Studies of emotionally supportive relationships with teachers also have examined academic as well as social outcomes. For example, students' perceived support from teachers has been related to classroom grades and dropping out of school, as well as to motivational outcomes such as goal orientations, values, interest, and self-efficacy (see Wentzel, 2010, for a review). Eccles and her colleagues (Feldlaufer, Midgley, & Eccles, 1988; Midgley, Feldlaufer, & Eccles, 1989) found that young adolescents report declines in the nurturant qualities of teacher-student relationships after the transition to middle school that correspond to declines in academic motivation and achievement (see also Harter, 1996).

Relationships With Peers

Relationships with peers are of central importance to children throughout childhood and adolescence. They provide companionship and entertainment, help in solving problems, offer personal validation and emotional support, and especially during adolescence, build a foundation for identity development (Parker & Asher, 1993). In addition, positive peer interactions tend to promote the development of perspective-taking and empathic skills that serve as bases for cooperative, prosocial, and nonaggressive types of behavior (e.g., Youniss & Smollar, 1989). Positive relationships with peers also have been related consistently to a range of positive academically related accomplishments (Wentzel, 2005).

Researchers typically have studied children's involvement with peers at school in two ways. As described in the following sections, peer relationships at school are studied most frequently with regard to the degree of peer acceptance by the larger peer group, membership in specific peer groups, and dyadic friendships. Although not the focus of the current discussion, peer relationships also are examined within structured interactions related to instruction (see Wentzel & Watkins, 2011).

Peer Acceptance and Sociometric Status

An extensive body of work supports the notion that peer acceptance and peer sociometric status are related to children's motivational and academic functioning at school (Wentzel, 2005). Peer acceptance and sociometric status variables typically are based on unilateral assessments of a child's relative standing or reputation within the peer group. Scores reflect either a continuum of social preference ranging from well-accepted to rejected (e.g., How much do you like this person?), or assignment to a sociometric status group (i.e., popular, rejected, neglected, controversial, and average status; see Asher & Dodge, 1986).

Research indicates that sociometrically popular children (those who are well-liked and not disliked by peers) are academically proficient, whereas sociometrically rejected children (those who are not well-liked and highly disliked) experience academic difficulties; studies based on social preference scores yield highly similar findings (see Wentzel, 2005, for a review). Results are most consistent with respect to classroom grades, although peer acceptance has been related positively to standardized test scores as well as to IQ. These findings are robust for elementary-aged children as well as adolescents, and longitudinal studies document the stability of relations between peer acceptance and academic accomplishments over time. Sociometric status and peer acceptance also have been related to positive aspects of academic motivation, including pursuit of goals to learn, interest in school, and perceived academic competence.

An extensive body of work also has documented associations between peer acceptance and social behavioral outcomes. In general, when compared to their average status peers, popular students tend to be more prosocial and sociable and less aggressive, and rejected students less compliant, less self-assured, less sociable, and more aggressive and withdrawn (Newcomb, Bukowski, & Pattee, 1993). Peer status also has been related to prosocial and socially responsible goal pursuit during middle school (Wentzel, 1991a). For example, when compared with average status children, popular children tend to report more frequent pursuit of prosocial goals. Students who are "neglected" (i.e., neither well-liked or highly disliked by their peers) also report more frequent pursuit of prosocial and social responsibility goals, whereas "controversial" students (i.e., either highly well-liked or highly disliked) report less frequent pursuit of responsibility goals.

Peer Crowds and Groups

Students' membership in specific peer crowds and groups has been studied most frequently in adolescent samples (see Brown, 1989). Typical adolescent crowds include "Populars," students who engage in positive forms of academic as well as social behavior but also in some delinquent activities; "Jocks," students characterized by athletic accomplishments but also relatively frequent alcohol use; more alienated groups (e.g., "Druggies") characterized by poor academic performance and engagement in delinquent and other illicit activities; and "Normals," who tend to be fairly average students who do not engage in delinquent activities. Research on peer group membership has been mostly descriptive, identifying the central norms and values that uniquely characterize adolescent crowds (e.g., Brown, Mory, & Kinney, 1994). Moreover, in contrast to sociometrically popular students who are typically characterized in positive terms, members of "Popular" crowds are often described in negative terms such as being dominant and exclusionary (Parkhurst & Hopmeyer, 1998).

The influence of peer crowds on adolescent functioning is illuminated in ethnographic studies that describe how peer crowds facilitate the formation of students' identity and self-concept and structure their ongoing social interactions (Brown, 1989). With respect to identity formation, crowds are believed to provide adolescents with values, norms, and interaction styles that are sanctioned and commonly displayed. Behaviors that are characteristic of a crowd are modeled frequently so that they can be learned easily and adopted by individuals. In this manner, crowds provide prototypical examples of various identities for those who wish to "try out" different lifestyles, and in doing so, can affirm an adolescent's sense of self. The power of crowd influence also is reflected in relations between crowd membership and adolescents' attitudes toward academic achievement. Clasen and Brown (1985) found that adolescent peer groups differ in the degree to which they pressure members to become involved in academic activities, with "Jocks" and "Popular" groups providing significantly more pressure for academic involvement than other groups.

In addition, researchers who identify friendship-based peer groups using statistical procedures also have found relations between group membership and academic performance and academic engagement (e.g., Hamm, Schmid, Farmer, & Locke, 2011; Wilson, Karimpour, & Rodkin, 2011). Kindermann (1993; Kindermann, McCollam, & Gibson, 1996) reported that elementary-aged students tend to self-select into groups of peers that have motivational orientations to school similar to their own. Over the course of the school year, these orientations became stronger and more similar within groups (see also Berndt, Laychak, & Park, 1990). Friendship-based groups in middle school also have been related to changes over the course of the school year in the degree to which students perform academically (A. Ryan, 2001; Wentzel & Caldwell, 1997), although few have documented long-term relations between group membership and academic performance (e.g., Wentzel & Caldwell, 1997).

Friendships

Peer relationships also are studied with respect to dyadic friendships. In this case, students are asked to nominate their best friends at school; nominations are then matched to determine reciprocity, or best friendships. The central distinction between having friends and involvement with larger peer groups is that friendships reflect relatively private, egalitarian relationships often formed on the basis of idiosyncratic criteria. In contrast, peer groups are defined by publicly acknowledged and therefore easily identified and predictable characteristics that are valued by the group. In addition, whereas friendships are enduring aspects of children's peer relationships at all ages, peer groups and crowds emerge primarily during middle school, peak at the beginning of high school, and then diminish in prevalence as well as influence by the end of high school (Brown, 1989).

Friendships have been described most often with respect to their functions (Furman, 1989) and their qualities (Parker & Asher, 1993). However, simply having a friend at school appears to be related to a range of positive outcomes. Children with friends tend to be more sociable, cooperative, and self-confident when compared to their peers without friends; children with reciprocated friendships also tend to be more independent, emotionally supportive, altruistic, and prosocial, and less aggressive than those who do not have such friendships (Newcomb & Bagwell, 1995).

Similar to other types of peer relationships, having friends also has been related positively to grades and test scores in elementary school and middle school (Berndt & Keefe, 1995; Wentzel & Caldwell, 1997; Wentzel et al., 2004). In addition, having friends at school has been related to positive aspects of motivation and engagement in school-related activities (see Wentzel, 2005). In this regard, children entering kindergarten with existing friends, and those who make new friends quickly, appear to make better social and academic adjustments to school than those who do not (Ladd, 1990; Ladd & Price, 1987). Similar findings have been reported for students making the transition to middle school (Wentzel et al., 2004). During adolescence, friends are likely to support academic engagement in the form of studying and making plans for college (e.g., Berndt et al., 1990; Epstein, 1983). Finally, the quality of friendships has been related negatively to undesirable behavioral outcomes (Crosnoe & Needham, 2004), and friend's positive characteristics have been related to students' displays of prosocial behavior (Wentzel et al., 2004) and academic achievement (Véronneau & Dishion, 2011).

Summary

Although teachers' and students' goals for education have not been studied extensively, it is clear that a core set of competencies are valued by teachers as well as students. In addition to academic accomplishments, positive forms of behavior that are reflected in compliance to classroom rules and norms and that demonstrate cooperation and caring for classmates also appear to be valued. Students themselves also mention trying to achieve these same outcomes although they also mention more personal goals such as to have fun and to develop relationships with peers. Of relevance for this chapter is that pursuit of goals to behave in prosocial and responsible ways, as well as actual displays of these behaviors are related positively to each other as well as to a range of motivational and academic performance outcomes. Establishing positive interpersonal relationships with teachers and peers also appears to be an important social outcome in its own right, but also as a correlate of social goal pursuit, behavioral competence, and academic outcomes.

Of central importance to a discussion of school adjustment, however, is how these various social competencies develop in the first place and how we might intervene to facilitate positive engagement when it has not occurred. One common explanation for how social influence takes place focuses on the motivational significance of children's social relationships. From a developmental perspective, relationships are believed to be experienced through the lens of mental representations developed over time and with respect to specific experiences (Bowlby, 1969; Laible & Thompson, 2007). In general, it is hypothesized that children are more likely to adopt and internalize goals that are valued by others when their relationships are perceived as being nurturant and supportive than if their relationships are harsh and critical (see Grusec & Goodnow, 1994). In turn, if goals for socially desirable outcomes have been internalized, efforts to achieve these goals and corresponding displays of appropriate behavior are likely to follow (Wentzel, 1991a, 1994). This process is supported by the evidence reviewed in the previous section.

Given the centrality of goal pursuit and behavioral competence as components of social engagement at school, the role of interpersonal relationships with teachers and peers in supporting students' pursuit of positive social goals and displays of corresponding behavior are the focus of the following section. Relations with academically related outcomes also are described.

SOCIAL INFLUENCES ON SCHOOL ADJUSTMENT

In general, the models used to guide research on the influence of interpersonal relationships on students' school-related outcomes propose causal pathways by which affectively close and supportive relationships influence a wide range of competencies, primarily by promoting a positive sense of self and emotional well-being, and a willingness to engage with the environment. In line with attachment theory principles (e.g., Bretherton, 1987), evidence from correlational studies confirms that secure and close relationships with teachers and peers are related positively to children's motivation toward school and associated cognitive and social competencies. Similarly, work based on social support perspectives (Cohen & Wills, 1985; Sarason, Sarason, & Pierce, 1990) and self-determination theory (R. M. Ryan & Deci, 2000) provides evidence of associations between the affective quality of relationships and older students' motivation and school-related outcomes (see Wentzel, 2005, 2009, for reviews). An additional approach to the study of teacher-student and peer relationships has been to consider relationships as serving a broader range of functions that contribute to students' competence at school. For the most part, scholars adopting this approach have focused on teachers as socialization agents who create interpersonal contexts that influence levels and quality of student motivation and engagement (see Connell & Wellborn, 1991; Wentzel, 2004, 2005). Although the affective tone of interpersonal interactions is a central focus of discussion, these perspectives propose that the contribution of teachers' and peers' relationships with students should be defined in terms of multiple dimensions that combine with emotional support to motivate students to engage in the social and academic life of school.

Similar to those described in models of effective parenting and parenting styles (e.g., Baumrind, 1971; Darling & Steinberg, 1993), these dimensions reflect levels of predictability and structure, instrumental resources, and concern with a student's emotional and physical well-being. These dimensions are believed to reflect necessary types of interpersonal resources that support a student's pursuit of personal goals but also their willingness to learn about and then actively pursue those social and academic goals that are valued by others at school. Moreover, as a set of interacting processes, these dimensions create a climate within which specific instructional practices and academic content is delivered. The degree to which these practices and content are learned depends on the quality of the relationship climate (Steinberg, 2001).

Wentzel (2004, 2005) describes more specifically how teacher-student and peer interactions along these dimensions can promote student motivation and academic performance. Specifically, she suggests that students will come to value and subsequently pursue academic and social goals valued by teachers and peers when they perceive their interactions and relationships with them as providing clear direction concerning goals that should be achieved; as facilitating the achievement of their goals by providing help, advice, and instruction; as being safe and responsive to their goal strivings; and as being emotionally supportive and nurturing (see also Ford, 1992). In this manner, students' school-based competencies are a product of social reciprocity between teachers and their classmates. Just as students must behave in ways that meet the expectations of others, so must teachers and peers provide support for the achievement of students' goals. Students' motivation to achieve academic and social goals that are personally as well as socially valued should then serve as mediators between opportunities afforded by positive interactions with teachers and peers, and their academic and social accomplishments. In the following sections, evidence that these dimensions of support can promote social and academic accomplishments by motivating students to display positive forms of social behavior and to engage in academic activities is reviewed.

Teacher Communications and Expectations

It is reasonable to assume that the degree to which students pursue goals valued by teachers is dependent on whether teachers communicate clearly and consistently their values and expectations concerning classroom behavior and performance. As with parents, teachers vary in the degree to which they interact with their students in consistent and predictable ways (Wentzel, 2002b). Moreover, clarity of communications and consistency of classroom management practices early in the academic year tends to predict positive academic and social outcomes in elementary and secondary level classrooms (see Gettinger & Kohler, 2006). Presumably, these practices promote a climate of interpersonal trust and fairness that promotes students' willingness to listen to teacher communications and adopt their behavioral and learning goals and values.

Beyond communicating values and expectations for behavior and achievement at the classroom level, teachers also convey expectations about ability and performance to individual students. As part of ongoing interpersonal interactions, these communications have the potential to influence a student's beliefs about her own ability and goals to achieve academically. R. S. Weinstein (2002) describes these communications as part of a process of influence whereby teachers' expectations result in their differential treatment of students. These communications most often reflect beliefs that students are able to achieve more than previously demonstrated, or negative expectations reflecting underestimations of student ability. Teachers' negative expectations are often targeted toward minority students, with expectations for competent behavior and academic performance being lower for them than for other students (see, e.g., Oates, 2003; Weinstein, Gregory, & Strambler, 2004).

Teachers' false expectations can become self-fulfilling prophecies, with student performance changing to conform to teacher expectations (see Weinstein, 2002), especially as students get older (Valeski & Stipek, 2001). Although the effects of these negative expectations appear to be fairly weak and short-lived, self-fulfilling prophecies tend to have stronger effects on students who are African-American, from low socioeconomic backgrounds, and low achievers (see Jussim, Robustelli, & Cain, 2009). In addition, however, teachers' overestimations of ability seem to have a somewhat stronger effect in raising levels of achievement than teachers' underestimates have on lowering achievement, especially for low performing students (Madon, Jussim, & Eccles, 1997). Therefore, teachers who communicate high expectations for individual students can bring about positive changes in academic accomplishments. However, the direct impact of these expectations on student motivation has been examined infrequently (see Jussim et al., 2009).

Peer Communication of Expectations and Values

Although children articulate sets of goals that they would like and expect each other to achieve, specific aspects of peer contexts that lead children to adopt these goals and values are not well understood. However, the larger peer group can be a source of behavioral standards, and group pressures can provide a mechanism whereby adherence to group standards is monitored and enforced. It should be noted that peer monitoring of behavior will contribute to the development of competencies valued by teachers and other adults only insofar as the peer group believes that adult standards for achievement and norms for conduct are important and legitimate. As children enter adolescence, however, they are less likely to acknowledge the legitimacy of adult-imposed norms (Smetana & Bitz, 1996) or automatically enforce classroom rules (Eccles & Midgley, 1989). Therefore, dependence on peer monitoring to enforce adult-generated rules might not be appropriate for many older students.

Peers also can contribute to students' goals and expectations for performance by influencing perceptions of ability. This is important for understanding academic competence because students' efficacy beliefs are powerful predictors of academic performance (Schunk & Pajares, 2009). Children utilize their peers for comparative purposes as early as 4 years of age (Butler, 2005). As children work on academic tasks that require specific skills and are evaluated with respect to clearly defined standards, they use each other to monitor and evaluate their own abilities. Experimental work also has shown that peers serve as powerful models that influence the development of academic self-efficacy (Schunk & Pajares), especially when children observe similar peers who demonstrate successful ways to cope with failure. These modeling effects are especially likely to occur when students are friends (Crockett, Losoff, & Petersen, 1984).

Teachers' Provisions of Help, Advice, and Instruction

In the classroom, teachers play the central role of transmitting knowledge and training students in academic subject areas. In this role, teachers routinely provide children with resources that directly promote the development of social and academic competencies. These resources can take the form of information and advice, modeled behavior, or specific experiences that facilitate learning as well as interpersonal competence (e.g., Russell, Wentzel, & Donlan, 2011). The fact that teachers vary in the amount of help and instruction they offer to students is reflected in evidence that children's willingness to seek help from teachers is related to several factors, including the availability of emotional support, structure, and autonomy (Newman, 2000). Little is known about teacher characteristics that predict their willingness to help students. However, Brophy and Good (1974) documented the relevance of teachers' relationships with elementary-aged students for gaining access to academic resources. The teachers observed in their research reported that they were more appreciative and positive toward students who were cooperative and persistent (i.e., behaviorally competent) than toward students who were less cooperative but displayed high levels of creativity and achievement. Teachers also responded with help and encouragement to students about whom they were concerned when these students sought them out for help. In contrast, students toward whom they felt rejection were treated most often with criticism and typically were refused help.

Experimental work also suggests that the nature of teachers' responses to students' poor academic performance tends to vary as a function of their attributions for these outcomes (Reyna & Weiner, 2001). Specifically, teachers were prone to anger when students were perceived to fail for reasons that were under their control; when reasons for student failure were perceived to be uncontrollable, teachers tended to express sympathy. Of interest for understanding willingness to help, teachers in this study reported a greater likelihood to respond to controllable failures with punishment rather than with help. Given these findings, understanding why teachers like some students but not others, and identifying the reasons that teachers attribute to individual students' classroom behavior and academic performance is an important area of study that should not be ignored.

Peer Provisions of Help, Advice, and Instruction

Help giving is perhaps the most explicit and obvious way in which peers can have a direct influence on students' academic and social competence. Indeed, students who enjoy positive relationships with their peers will also have greater access to resources and information that can help them accomplish academic and social tasks than those who do not. These resources can take the form of information and advice, modeled behavior, or specific experiences that facilitate learning specific skills (e.g., Schunk, 1987). At least during adolescence, students report that their peers are as or more important sources of instrumental aid than their teachers (Lempers & Clark-Lempers, 1992).

Longitudinal studies of peer help giving are rare. However, findings on middle school students making the transition into high school suggest that receiving academic help from familiar peers tends to increase over the course of the transition (Wentzel et al., 2007). One reason for this growing dependence on peers is that when adolescents enter high school, the relative uncertainty and ambiguity of having multiple teachers and different sets of classmates for each class, new instructional styles, and more complex class schedules necessitates that they turn to each other for social support, ways to cope, and academic help.

Teacher Emotional Support and Safety

In conjunction with communicating clear expectations and providing instrumental help, teachers also create contexts characterized by levels of emotional support and personal safety (Connell & Wellborn, 1991; Isakson, & Jarvis, 1999). As noted earlier, the work on affective qualities of teacher-student relationships supports the notion that emotionally supportive interactions have the potential to provide strong incentives for students to engage in valued classroom activities. An additional aspect of teachers' emotional support is reflected in their efforts to protect students' physical well-being. Most frequently, issues of student safety are discussed with regard to peer interactions. National surveys indicate that large numbers of students are the targets of classmate aggression and take active measures to avoid being harmed physically as well as psychologically by peers (National Center for Educational Statistics, 1995). Although this literature implies that peers might be the primary source of threats to students' physical safety and well-being, of central importance to understanding this process is that teachers can play a central role in creating classrooms that are free of peer harassment and in alleviating the negative effects of harassment once it has occurred (Olweus, 1993). Of special interest are findings that students are more likely to enjoy affectively positive relationships with teachers when they feel safe at school (Crosnoe, Johnson, & Elder, 2004).

Peer Emotional Support and Safety

Also noted earlier, students who perceive that their peers support and care about them tend to be interested and engaged in academic pursuits, whereas students who do not perceive their relationships with peers as positive and supportive tend to be at risk for motivational and academic problems. One explanation for these findings is that exclusion from supportive peer relationships can result in negative outcomes in the form of emotional distress. Children without friends or who are socially rejected often report feeling lonely, emotionally distressed, and depressed (e.g., Buhs & Ladd, 2001; Flook, Repetti, & Ullman, 2005; Wentzel & Caldwell, 1997). These negative forms of affect also are likely to result in negative attitudes toward school and academic performance, as well as school avoidance and low levels of classroom participation (Buhs & Ladd, 2001; Wentzel, Weinberger, Ford, & Feldman, 1990). Therefore, affective functioning is likely to mediate relations between peer activities and social and academic outcomes (e.g., Juvonen, Nishina, & Graham, 2000).

In addition, students who are accepted by their peers and who have established friendships with classmates also are more likely to enjoy a relatively safe school environment and less likely to be the targets of peer-directed violence and harassment than their peers who do not have friends (Hodges, Boivin, Vitaro, & Bukowski, 1999; Schwartz, Dodge, Pettit, Bates, & the Conduct Problems Prevention Research Group, 2000). In addition, young children who have friends who display prosocial behavior are less likely to respond in a hostile or impulsive manner in response to peer provocation or bullying behaviors than are children without highly prosocial friends (Lamarche et al., 2006). Presumably, this is because prosocial friends are able to provide instrumental help as well model effective ways to decrease and defuse threats from peers.

The general effects of peer harassment on student motivation and academic competence have not been studied frequently. However, students who are frequently victimized also tend to report higher levels of distress and depression than those who are not routinely victimized (e.g., Kochenderfer-Ladd & Waldrop, 2001; Olweus, 1993). Few studies have identified pathways whereby peer victimization and harassment affect academic outcomes. However, as with perceived support, peer abuse and exclusion is likely to be associated with academic achievement by way of emotional distress (Buhs, 2005; Flook et al., 2005). Therefore, although indirect, having supportive peers in these negatively charged situations can have positive effects on a wide range of social, motivational, and academic outcomes.

Conclusions and Provocations for the Field

Throughout this chapter, I have highlighted the importance of defining school adjustment within an ecological, competence-based framework. In doing so, I have documented the importance of social motivational processes, behavioral competence, and interpersonal relationships not only as critical aspects of school adjustment, but as a complex and interrelated set of outcomes that contribute to academic accomplishments. In addition, work that underscores the importance of students' interpersonal relationships with teachers and peers in promoting healthy and adaptive functioning at school has been described. Although definitions of school adjustment and the relative importance of various outcomes are likely to vary depending on context-specific values and norms of a classroom, the literature provides strong support for the notion that general levels of adjustment require personal attributes such as the ability to coordinate multiple goals, motivation to behave in socially desirable ways, and the social skills necessary to behave in socially competent ways. In turn, it appears that the development of these personal attributes can be supported by developmentally appropriate expectations for behavior, as well as provisions of emotional and social support, consistency and structure, instrumental help, and safety on the part of teachers and peers.

Beyond these basic observations, however, many interesting and provocative questions remain. In conclusion, therefore, I would like to raise several general issues in need of additional consideration and empirical investigation if we are to make progress in understanding children's adjustment to school. These issues concern the expectations and goals we hold for our students, the role of developmental processes in choosing these goals (and therefore, in how we view healthy adjustment), the development of more sophisticated models to guide research on school adjustment, and research methods and designs.

Defining School Adjustment

Perhaps our most important task as researchers and educators is to come to terms with the questions raised at the beginning of this chapter: What are our educational goals for our children? Do we want to teach simply to the test or nurture our children in ways that will help them become productive and healthy adults and citizens? By the same token, what are the goals that children bring with them to school? Do they strive to excel in relation to their peers, satisfy their curiosities, get along with others, or simply feel safe? In order to understand fully children's adjustment to school, it is imperative that we continue to seek answers to these questions and identify ways to coordinate these often antagonistic goals to achieve a healthy balance of multiple objectives. Indeed, the process of achieving more adaptive levels of adjustment will always include negotiations and coordination of the multiple and often conflicting goals of teachers, peers, students themselves, and their parents.

Although we are beginning to understand the basic goals that most teachers and students wish to achieve, we know little about how and why students come to learn about and to adopt these goals as their own. For instance, how do teachers communicate their expectations and goals to students and which factors predispose students to accept or reject these communications? We know that parental messages are more likely to be perceived accurately by children if they are clear and consistent, are framed in ways that are relevant and meaningful to the child, require decoding and processing by the child, and are perceived by the child to be of clear importance to the parent, and as being conveyed with positive intentions (Grusec & Goodnow, 1994). Do these same factors reflect effective forms of teacher-student communication and if so, can we teach teachers to communicate goals and expectations to their students in similar ways?

Of additional concern is that explanations of competence based on students' pursuit of socially valued goals assume that students understand how they are supposed to behave and what it is they are supposed to accomplish while at school. For some students these expectations are not always immediately obvious. In particular, young children who are just beginning school and students who are raised in cultures with goals and values dissimilar to those espoused by educational institutions might also need explicit guidance with respect to the goals they are expected to achieve (Ogbu, 1985). It is clear that teachers do not always communicate clearly their own goals for their students. For example, students often report that their teachers did not have clear classroom rules for them to follow nor do they think their teachers explain what would happen if rules were broken (Wentzel, 2000a; Wentzel et al., 2010). Therefore, the more that teachers can make the social expectations for classroom conduct explicit and clearly defined, the more likely students will at least understand the goals they are expected to achieve. In addition, research has begun to delineate the important role of parents and peers in communicating goals to behave appropriately at school (Wentzel, Baker, & Russell, 2011; Wentzel, Russell, Garza, & Merchant, 2011). The study of multiple sources of information concerning valued goals for students, and how they combine to influence students' pursuit of school-related goals is an important challenge for future research in this area.

Similarly, we need to focus on understanding student characteristics that facilitate their acceptance of teachers' communications. Motivational factors such as perceived autonomy, competence, and belongingness (e.g., Connell & Wellborn, 1991), and social-emotional competencies such as the ability to experience empathy and interpersonal trust (see Grusec & Goodnow, 1994) are well-documented correlates of compliance with, if not internalization of, socially valued goals. Other factors such as students' beliefs regarding the fairness, relevance, and developmental appropriateness of teachers' goals and expectations also need to be investigated in this regard (e.g., Smetana & Bitz, 1996). Finally, social information processing skills that determine which social messages and cues are attended to, how they are interpreted, and how they are responded to are a critical component of socially competent behavior (Crick & Dodge, 1994). These skills have been widely researched in the area of peer relationships; extending our knowledge of their influence to the realm of teacher-student relationships and adaptation to classroom contexts is a necessary next step in research on school adjustment.

Developmental Processes

If the achievement of socially valued goals is accepted as a critical component of school adjustment, investigations of appropriate goals and expectations also must be conducted within a developmental framework, taking into account the age-related capabilities of the child. Issues of developmentally appropriate practices have been addressed primarily at the level of preschool education. However, a consideration of developmental issues is critically important for students of all ages. To illustrate, Grolnick (Grolnick, Kurowski, & Gurland, 1999) argues that children face normative motivational challenges as they make their way through school, with issues of social integration defining the transition to school, the development self-regulatory skills and positive perceptions of autonomy and competence defining the elementary years, and flexible coping and adaptation to new environments marking the transitions into middle and high school. The undertaking and mastery of these developmental tasks as they relate to school activities need to be incorporated into definitions and models of school adjustment and recognized as core competencies that children need to achieve as they progress through their school-aged years.

A developmental focus also is necessary for understanding the demands of teachers on students of different ages. Researchers have observed that teachers treat students differently and focus on different tasks and goals depending on the age of their students (e.g., Brophy & Good, 1974; Eccles & Midgley, 1989). At this point, we do not know if changing developmental needs of students or normative and societal expectations for children at different ages drive these differences. However, if we are to understand the nature and requirements of school adjustment, a critical look at the abilities of children at different ages as well as the normative requirements for competent classroom functioning is necessary. Systematic longitudinal and experimental research is necessary to tease apart the relative contributions of children and teachers to patterns of classroom behavior and student-teacher interactions that appear to change across the elementary, middle and high school years.

Developmental issues also are important with respect to the influence of teachers' communications on students' beliefs about behavior at school. For example, Smetana and Bitz (1996) reported that almost all adolescents believe that teachers have authority over issues such as stealing and fighting, somewhat less authority over issues such as misbehaving in class, breaking school rules, and smoking or substance abuse, and least authority over issues involving peer interactions, friendships and personal appearance. Moreover, when compared to beliefs about the authority of their parents and friends to dictate their school behavior, adolescents reported that teachers have more authority with respect to moral issues such as stealing and fighting and conventional rules involving school and classroom conduct. Adolescent students also believed that teachers have as much authority as parents with respect to smoking or substance abuse. These beliefs, however, tended to change as children got older, with younger adolescents in middle school reporting that teachers have legitimate authority in all areas of school conduct and older adolescents in high school believing that teachers have little authority over most aspects of their lives at school.

Theory Building

Theoretically based models of school adjustment are not well developed. In particular, the role of context as it interacts with individual differences and psychological processes needs careful and systematic consideration. First, the evidence described in this chapter suggests that models of socialization might be well-suited for understanding which goals children pursue at school and the degree to which these goals have been internalized and represent personal values. Socialization models are especially important to consider with respect to the content of students' goals, given that successful students must achieve social and academic objectives that are imposed externally by adults. In this regard, it is important to note that some students reject these goals outright. It is likely that other students merely comply with these expectations and present the impression that they are interested in achieving what is required when in fact, they are not (see Juvonen, 1996; Sivan, 1986). Some students, however, are likely to have internalized adult-valued goals and are committed to achieving them regardless of competing expectations. Therefore, identifying the precise socialization experiences that lead to these fundamentally different orientations toward learning remains a significant challenge to the field.

Perhaps one of the more interesting questions with respect to socialization within teacher and peer contexts is the strength of influence when compared to that of parents. As reported by Wentzel (2009), findings from studies that included assessments of parent and teacher emotional support suggest that the effects of support from teachers might be domain and classroom specific, with teacher support being related most strongly to those outcomes to which teachers contribute most, such as subject matter interest and classroom behavior. Qualities of teacher-student relationships also appear to moderate the effects of parent-child relationships on students' motivation at school, especially when parents are not supportive. The conjoint influence of teacher and peer relationships has been studied less frequently, although evidence suggests that each type of relationship has somewhat unique effects on student outcomes, with peers having a stronger effect on classroom behavior than teachers, especially during the early adolescent years.

However, it also appears that the existence or quality of peer relationships are not destined to influence school-related outcomes negatively *or* positively if supportive relationships with parents or teachers exist. With respect to practice, these findings imply that although peer influence might be strong, it can be superseded. In fact, interventions to offset the often negative influence of peer groups and gangs might be especially successful if children are exposed to interactions with adults who can instill a sense of autonomy, mutuality, warmth, and guidance into their relationships with these children (see Heath & McLaughlin, 1993). Moreover, peer group membership tends to change frequently, suggesting that influence by a particular group might also be fairly transient. Therefore, having access to adult relationships that are stable and predictable also should contribute positively to intervention efforts.

In addition, models need to consider the possible ways in which children and the various social systems in which they develop, including home, peer groups, and schools, interact to create definitions of school-related competence (see Bronfenbrenner, 1989). In this regard, models that incorporate lay theories of what it means to be successful, and beliefs concerning how success is achieved are essential (see, Ogbu, 1985; Sternberg & Kolligian, 1990). How these beliefs change as children develop and ways in which they contribute to children's developing school-related goal hierarchies should be a primary target of researchers' efforts. Models of socialization also need to be developed with specific types of social relationship configurations in mind (e.g., dyads versus groups; friendships versus acquaintanceships), and perhaps modified depending on whether the relationships are with parents, peers, or teachers, and whether the target student is in elementary, middle, or high school.

The impact of other social context factors such as gender, race, and culture also needs to be incorporated into the model. Continued research on classroom reward structures (Slavin, 2011), organizational culture and climate (Roeser, Urdan, & Stephens, 2009), and person-environment fit (Eccles & Midgley, 1989) also can inform our understanding of how the social institutions and contexts within which learning takes place can motivate children to learn and behave in very specific ways. Given the importance of context-related provisions and supports for understanding students' social engagement and academic achievement, it also becomes critical to understand how these supportive contexts can be promoted and sustained over time. Work in the area of peer relationships has provided evidence that teachers' beliefs and behaviors, classroom organization, and school-wide structure, composition, and climate affects students' choice of friends and general propensity to make friends, as well as levels of peer acceptance and friendship networks in classrooms (see Wentzel, Baker, & Russell, 2009). Work on teacher-student relationships has been less frequent although professional development efforts to improve teachers' classroom management strategies (Evertson & Weinstein, 2006), disciplinary strategies (Developmental Studies Center), and interpersonal interactions and relationships with students (Pianta, 2006) have shown promise. Therefore, work that clearly delineates the processes and mechanisms whereby contexts can be improved warrants careful attention.

Development and testing of theoretical models that explain links between social goal pursuit and academic achievement also is needed. At the simplest level, positive relations between social motivation and academic variables might reflect that students are rewarded for their social efforts with good grades. Goals to achieve social and academic outcomes might also be related in more complex fashion, functioning in an interdependent, hierarchical manner (Dowson and McInerney, 2003; Kiefer & Ryan, 2008; Wentzel, 2003). For instance, goal hierarchies can develop over time as individuals are taught to prioritize goals and to associate goals with each other in causal fashion (Pervin, 1983). To illustrate, children might come to school with a basic goal to establish positive relationships with others. Over time, this goal might become linked causally to more specific goals such as to establish a positive relationship with teachers. This relationship goal might be accomplished by pursuing even more specific academic goals such as to pay attention, to complete assignments, or to perform well on tests. Similarly, children might learn that in order to achieve social approval and acceptance they first must achieve subordinate goals such as learning subject matter or supporting group efforts (see Ames, 1992). In this manner, students come to recognize which goals are most important to achieve and how the attainment of one set of goals can lead to the attainment of others. Therefore, social goal pursuit needs to be examined as part of a coordinated effort to achieve multiple classroom goals. An identification of specific self-regulatory strategies that enable students to accomplish multiple goals simultaneously seems essential for helping students coordinate demands to achieve multiple and often conflicting goals at school.

Clear and consistent relations between students' prosocial and responsible classroom behavior and their academic accomplishments also have been documented. As with goal pursuit and achievement, however, research on why these relations exist is rare, despite ongoing and serious concerns about students' classroom behavior and how to manage it (see Evertson & Weinstein, 2006). Nevertheless, there are several ways that social behavior can contribute to achievement at school. First, prosocial and responsible behavior can contribute to academic achievement by creating a context conducive to learning. This can occur when children conform to rules for social conduct such as to pay attention, cooperate with others, and to restrain from aggressive or disruptive behavior. In addition, being socially responsible also means conforming to rules and conventions for completing learning activities; teachers provide students with procedures for accomplishing academic tasks and dictate specific criteria and standards for performance. Quite simply, students' adherence to classroom rules and displays of socially competent behavior allows teachers to focus their efforts on teaching rather than classroom management. Presumably, all students will learn more when this occurs. In addition, constructivist theories of development (Piaget, 1965; Youniss & Smollar, 1989) propose that positive social interactions (e.g., cooperative and collaborative problem solving) can create cognitive conflict that hastens the development of higher-order thinking skills and cognitive structures. Empirical research supports this notion in that cooperative learning results in greatest gains when interactive questioning and explanation are an explicit part of the learning task (e.g., Slavin, 2011; Wentzel & Watkins, 2011).

Theoretical considerations of school adjustment also must continue to focus on underlying psychological processes and skills that promote the development and display of adjustment outcomes. To illustrate, researchers have clearly established significant and powerful links between prosocial and socially responsible behaviors and academic accomplishments. What have not been identified, however, are the psychological underpinnings of these behaviors. Research on skills and strategies involved in emotion regulation (Eisenberg & Fabes, 1992), self-regulated learning (see Zimmerman & Cleary, 2009), social information processing (Crick & Dodge, 1994), and goal coordination (Boekarts, 2009; Wentzel, 2002a) might be particularly fruitful in determining the degree to which multiple aspects of school adjustment (e.g., prosocial behavior, academic performance) reflect a core set of psychological and emotional competencies as well as the degree to which social behaviors themselves contribute directly to learning outcomes.

A final issue with respect to theory, concerns the direction of effects. Assuming that causal relations do exist, is it that behavioral competence influences learning and achievement or that academic success promotes behavioral competence? It is clear that bidirectional influences exist. For instance, negative academic feedback can lead to acting out, noncompliance, and other forms of irresponsible behavior. From a developmental perspective, however, antisocial behavior and a lack of prosocial skills appear to begin with poor family relationships (e.g., Patterson & Bank, 1989). Therefore, how children are taught to behave before they enter school should have at least an initial impact on how they behave and subsequently learn at school. In addition, interventions designed to increase academic skills do not necessarily lead to decreases in antisocial behavior (Patterson, Bank, & Stoolmiller, 1990), nor do they enhance social skills typically associated with academic achievement (Hopps & Cobb, 1974). Therefore, it is reasonable to assume that at least to some degree, behavioral competence precedes academic competence at school.

Research Methods and Designs

Our current understanding of school adjustment is based primarily on correlational studies of white middle-class children. Correlational strategies have resulted in a wealth of data that can serve as a strong foundation for further theory building and research. However, continued investigations in this area would profit from extending these simple correlational designs to incorporate ethnographic as well as experimental components. For instance, understanding what constitutes school adjustment in a classroom or broader school setting requires in-depth conversations with and extensive observations of students and teachers as they carry out their day-to-day lives at school. In addition, identifying ways to promote school adjustment requires careful, systematic long-term intervention studies. Although such projects are rare, those involving experimentation and evaluation of progress are essential if we are to identify strategies and experiences that will improve the lives of students in significant ways.

In addition to design considerations, researchers also need to focus on more diverse samples. Although it is likely that the underlying psychological processes that contribute to school adjustment are similar for all students regardless of race, ethnicity, gender, or other contextual and demographic variables, the degree to which these latter factors interact with psychological processes to influence adjustment outcomes is not known. For instance, goal coordination skills might be more important for the adjustment of children from minority backgrounds than for children who come from families and communities whose goals and expectations are similar to those of the educational establishment (e.g., Fordham & Ogbu, 1986; Phelan, Davidson & Cao, 1991). Peer relationship skills might be especially important for adjustment in schools where peer cultures are particularly strong or where collaborative and cooperative learning is emphasized. Achieving a better understanding of such interactions deserves our full attention. Similarly, definitions of competence and adjustment are likely to vary as a function of race, gender, neighborhood, or family background. Expanding our database to include the voices of under-represented populations can only enrich our understanding of how and why children make successful adaptations to school.

REFERENCES

Allen, J. D. (1986). Classroom management: Students' perspectives, goals, and strategies. *American Educational Research Journal, 23*, 437–459.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*, 261–271.

Asher, S. R., & Dodge, K. A. (1986). Identifying children who are rejected by their peers. *Developmental Psychology, 22*, 444–449.

Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin, 120*, 338–375.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Baumrind, D. (1971). Current patterns of parental authority. *Developmental Psychology Monograph, 4*, (1, Pt.2).

Berndt, T. J., & Keefe, K. (1995). Friends' influence on adolescents' adjustment to school. *Child Development, 66*, 1312–1329.

Berndt, T. J., Laychak, A. E., & Park, K. (1990). Friends' influence on adolescents' academic achievement motivation: An experimental study. *Journal of Educational Psychology, 82*, 664–670.

Birch, S. H., & Ladd, G. W. (1997). The teacher-child relationship and children's early school adjustment. *Journal of School Psychology, 35*, 61–79.

Boekarts, M. (2009). Goal-directed behavior in the classroom. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 105–122). New York, NY: Taylor Francis.

Bowlby, J. (1969). Attachment and loss. *Attachment vol. 1*, New York, NY: Basic Books.

Bretherton, I. (1987). New perspectives on attachment relations: Security, communication and internal working models. In J. Osofsky (Ed.), *Handbook of infant development* (pp. 1061–1100). New York, NY: Wiley.

Bronfenbrenner, U. (1989). Ecological systems theory. In R. Vasta (Ed.), *Annals of child development* (Vol. 6, pp. 187–250). Greenwich, CT: JAI.

Brophy, J. E., & Good, T. L. (1974). *Teacher student relationships: Causes and consequences*. New York, NY: Holt, Rinehart & Winston.

Brown, B. B. (1989). The role of peer groups in adolescents' adjustment to secondary school. In T. J. Berndt & G. W. Ladd (Eds.), *Peer relationships in child development* (pp. 188–215). New York, NY: Wiley.

Brown, B. B., Mory, M. S., & Kinney, D. (1994) Casting adolescent crowds in a relational perspective: Caricature, channel, and context. In R. Montemayor, G. R. Adams, & T. P. Gullotta, T. P. (Eds.), *Personal relationships during adolescence* (pp. 123–167). Newbury Park, CA: Sage.

Buhs, E. (2005). Peer rejection, negative peer treatment, and school adjustment: Self-concept and classroom engagement as mediating processes. *Journal of School Psychology, 43*, 407–424.

Buhs, E. S., & Ladd, G. W. (2001). Peer rejection as an antecedent of young children's school adjustment: An examination of mediating processes. *Developmental Psychology, 37*, 550–560.

Butler, R. (2005). Competence assessment, competence, and motivation between early and middle childhood. In A. Elliot & C. Dweck (Eds.), *Handbook of competence and motivation* (pp. 202–221). New York, NY: Guilford Press.

Clasen, D. R., & Brown, B. B. (1985). The multidimensionality of peer pressure in adolescence. *Journal of Youth and Adolescence, 14*, 451–468.

Cobb, J. A., & Hopps, H. (1973). Effects of academic survival skills training on low achieving first graders. *Journal of Educational Research, 67*, 108–113.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*, 310–357.

Collins, W. A., & Repinski, D. J. (1994). Relationships during adolescence: Continuity and change in interpersonal perspective. In R. Montemayor, G. Adams, & T. Gullotta (Eds.), *Personal relationships during adolescence* (pp. 7–36). Thousand Oaks, CA: Sage.

Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness: A motivational analysis of self-system processes. In M. R. Gunnar & L. A. Sroufe (Eds.), *Self processes and development: The Minnesota symposia on child development* (Vol. 23, pp. 43–78). Hillsdale, NJ: Erlbaum.

Crick, N., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*, 74–101.

Crockett, L., Losoff, M., & Petersen, A. C. (1984). Perceptions of the peer group and friendship in early adolescence. *Journal of Early Adolescence, 4*, 155–181.

Crosnoe, R., Johnson, M. K., & Elder, G. H. Jr. (2004). Intergenerational bonding in school: The behavioral and contextual correlates of student-teacher relationships. *Sociology of Education, 77*, 60–81.

Crosnoe, R., & Needham, B. (2004). Holism, contextual variability, and the study of friendships in adolescent development. *Child Development, 75*, 264–279.

Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological Bulletin, 113*, 487–496.

Davis, H. A. (2001). The quality and impact of relationships between elementary school students and teachers. *Contemporary Educational Psychology, 26*, 431–453.

Developmental Studies Center (n.d.). Retrieved from www.devstu.org/

Dodge, K. A. (1986). A social information processing model of social competence in children. In M. Perlmutter (Ed.), *Minnesota symposium on child psychology* (Vol. 18, pp. 77–126). Hillsdale, NJ: Erlbaum.

Doescher, S. M., & Sugawara, A. I. (1989). Encouraging prosocial behavior in young children. *Childhood Education, 65*, 213–216.

Dowson, M., & McInerney, D. M. (2003). What do students say about their motivational goals?: Towards a more complex and dynamic perspective on student motivation. *Contemporary Educational Psychology, 28*, 91–113.

Dweck, C. S. (1991). Self-theories and goals: Their role in motivation, personality, and development. In R. Dienstbier (Ed.), *Nebraska symposium on motivation* (Vol. 38, pp. 199–236). Lincoln: University of Nebraska Press.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256–272.

Eccles, J. S., & Midgley, C. (1989). Stage-environment fit: Developmentally appropriate classrooms for young adolescents. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 3, pp. 139–186). New York, NY: Academic Press.

Eisenberg, N., & Fabes, R. A. (1992). Emotion, regulation, and the development of social competence. In M. S. Clark (Ed.), *Review of personality and social psychology: Vol. 14. Emotional and social behavior* (pp. 119–150). Newbury Park, CA: Sage.

Epstein, J. L. (1983). The influence of friends on achievement and affective outcomes. In J. L. Epstein & N. Karweit (Eds.), *Friends in school* (pp. 177–200). New York, NY: Academic Press.

Evertson, C., & Weinstein, C. (2006). *Handbook of classroom management—Research, practice, and contemporary issues.* Mahwah, NJ: Erlbaum.

Feldhusen, J. F., Thurston, J. R., & Benning, J. J. (1970). Longitudinal analyses of classroom behavior and school achievement. *Journal of Experimental Education, 38*, 4–10.

Feldlaufer, H., Midgley, C., & Eccles, J. S. (1988). Student, teacher, and observer perceptions of the classroom before and after the transition to junior high school. *Journal of Early Adolescence, 8*, 133–156.

Flook, L., Repetti, R. L., & Ullman, J. B. (2005). Classroom social experiences as predictors of academic performance. *Developmental Psychology, 41*, 319–327.

Ford, M. E. (1984). Linking social-cognitive processes with effective social behavior: A living systems approach. In P. C. Kendall (Ed.), *Advances in cognitive-behavioral research and therapy* (Vol. 3, pp. 167–211). New York, NY: Academic Press.

Ford, M. E. (1992). *Motivating humans: Goals, emotions, and personal agency beliefs*. Newbury Park, CA: Sage.

Fordham, S., & Ogbu, J. U. (1986). Black students' school success; Coping with "the burden of 'acting white.'" *Urban Review, 18*, 176–206.

Furman, W. (1989). The development of children's social networks. In W. Furman, (Ed). *Children's social networks and social supports,* pp. 151–172. Oxford, England: Wiley.

Gettinger, M., & Kohler, K. M. (2006). Process-outcome approaches to classroom management and effective teaching. In C. Evertson & C. Weinstein (Eds.), *Handbook of classroom management—Research, practice, and contemporary issues* (pp. 73–96). Mahwah, NJ: Erlbaum.

Grolnick, W. S., Kurowski, C. O., & Gurland, S. T. (1999). Family processes and the development of children's self-regulation. *Educational Psychologist, 34*, 3–14.

Grusec, J. E., & Goodnow, J. J. (1994). Impact of parental discipline methods on the child's internalization of values: A reconceptualization of current points of view. *Developmental Psychology, 30*, 4–19.

Hagens, H. E. (1997). Strategies for encouraging peer interactions in infant/toddler programs. *Early Childhood Education Journal, 25*, 147–149.

Hamm, J. V., Schmid, L., Farmer, T., & Locke, B. (2011). Injunctive and descriptive peer group norms and the academic adjustment of rural early adolescents. *Journal of Early Adolescence, 31*, 41–73.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72*, 625–638.

Hargreaves, D. H., Hester, S. K., & Mellor, F. J. (1975). *Deviance in classrooms*. London, UK: Routledge & Kegan Paul.

Harter, S. (1996). Teacher and classmate influences on scholastic motivation, self-esteem, and level of voice in adolescents. In J. Juvonen & K. Wentzel (Eds.), *Social motivation: Understanding children's school adjustment* (pg. 11–42). New York, NY: Cambridge University Press.

Heath, S. B., & McLaughlin, M. W. (1993). *Identity and inner-city youth*. New York, NY: Teachers College Press.

Hinde, R. A. (1997). *Towards understanding relationships*. London, UK: Academic Press.

Hodges, E. V., Boivin, M., Vitaro, F., & Bukowski, W. M. (1999). The power of friendship: Protection against an escalating cycle of peer victimization. *Developmental Psychology, 35*, 94–101.

Hopps, H., & Cobb, J. A. (1974). Initial investigations into academic survival-skill training, direct instruction, and first-grade achievement. *Journal of Educational Psychology, 66*, 548–553.

Isakson, K., & Jarvis, P. (1999). The adjustment of adolescents during the transition into high school: A short-term longitudinal study. *Journal of Youth and Adolescence, 28*, 1–26.

Jussim, L., Robustelli, S., & Cain, T. (2009). Teacher expectations and self-fulfilling prophecies. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 349–380). New York, NY: Taylor Francis.

Juvonen, J. (1996). Self-presentation tactics promoting teacher and peer approval: The function of excuses and other clever explanations. In J. Juvonen & K. R. Wentzel (Eds.), *Social motivation: Understanding children's school adjustment* (pp. 43–65). New York, NY: Cambridge University Press.

Juvonen, J. (2006). Sense of belonging, social bonds, and school functioning. In P. Alexander & P. Winne (Eds.), *Handbook of educational psychology* (pp. 655–674). Mahwah, NJ: Erlbaum.

Juvonen, J., Nishina, A., & Graham, S. (2000). Peer harassment, psychological adjustment, and school functioning in early adolescence. *Journal of Educational Psychology, 92*, 349–359.

Kiefer, S., M., & Ryan, A. M. (2008). Striving for social dominance over peers: The implications for academic adjustment during early adolescence. *Journal of Educational Psychology, 100*, 417–428.

Kindermann, T. A. (1993). Natural peer groups as contexts for individual development: The case of children's motivation in school. *Developmental Psychology, 29*, 970–977.

Kindermann, T. A., McCollam, T. & Gibson, E. (1996). Peer networks and students' classroom engagement during childhood and adolescence. In J. Juvonen & K. R. Wentzel (Eds.), *Social motivation: Understanding children's school adjustment* (pp. 279–312). New York, NY: Cambridge University Press.

Kochenderfer-Ladd, B., & Waldrop, J. L. (2001). Chronicity and instability of children's peer victimization experiences as predictors of loneliness and social satisfaction trajectories. *Child Development, 72*, 134–151.

Ladd, G. W. (1990). Having friends, keeping friends, making friends, and being liked by peers in the classroom: Predictors of children's early school adjustment. *Child Development, 61*, 1081–1100.

Ladd, G. W., & Burgess, K. B. (2001). Do relational risks and protective factors moderate the linkages between childhood aggression and early psychological and school adjustment? *Child Development, 72*, 1579–1601.

Ladd, G. W., & Price, J. M. (1987). Predicting children's social and school adjustment following the transition from preschool to kindergarten. *Child Development, 58*, 1168–1189.

Laible, D., & Thompson, R. A. (2007). Early socialization: A relationship perspective. In J. Grusec & P. Hastings (Eds.), *Handbook of social development* (pp. 181–207). New York, NY: Guilford Press.

Lamarche, V., Brendgen, M., Boivin, M., Vitaro, F., Perusse, D., & Dionne, G. (2006). Do friendships and sibling relationships provide protection against peer victimization in a similar way? *Social Development, 15*, 373–393.

Lambert, N. M. (1972). Intellectual and non-intellectual predictors of high school status. *Journal of Special Education, 6*, 247–259.

Lempers, J. D., & Lempers-Clark, D. S. (1992). Young, middle, and late adolescents' comparisons of the functional importance of five significant relationships. *Journal of Youth and Adolescence, 21*, 53–96.

Madon, S., Jussim, L., & Eccles, J. (1997). In search of self-fulfilling prophecy. *Journal of Personality and Social Psychology, 72*, 791–809.

McClelland, D. C. (1987). *Human motivation*. New York, NY: Cambridge University Press.

Midgley, C., Feldlaufer, H., & Eccles, J. (1989). Student/teacher relations and attitudes toward mathematics before and after the transition to junior high school. *Child Development, 60*, 981–992.

Mitchell-Copeland, J., Denham, S. A., DeMulder, E. K. (1997). Q-Sort assessment of child-teacher attachment relationships and social competence in the preschool. *Early Education and Development, 8*, 27–40.

Murray, C., & Greenberg, M. T. (2000). Children's relationships with teachers and bonds with school: An investigation of patterns and correlates in middle childhood. *Journal of School Psychology, 38*, 423–445.

National Center for Educational Statistics. (1995). *Student strategies to avoid harm at school*. (NCES Publication No. NCES 95–203). Washington, DC: U.S. Government Printing Office.

Newcomb, A. F., & Bagwell, C. L. (1995). Children's friendship relations: A meta-analytic review. *Psychological Bulletin, 117*, 306–347.

Newcomb, A. F., Bukowski, W. M., & Pattee, L. (1993). Children's peer relations: A metaanalytic review of popular, rejected, neglected, and controversial sociometric status. *Psychological Bulletin, 113*, 99–128.

Newman, R. S. (2000). Social influences on the development of children's adaptive hold seeking: The role of parents, teachers, and peers. *Developmental Review, 20*, 350–404.

Oates, G. L. (2003). Teacher-student racial congruence, teacher perceptions, and test performance. *Social Science Quarterly, 84*, 508–525.

Ogbu, J. U. (1985). Origins of human competence: A cultural-ecological perspective. *Child Development, 52*, 413–429.

Olweus, D. (1993). Victimization by peers: Antecedents and long-term outcomes. In K. Rubin & J. B. Asendorf (Eds.), *Social withdrawal, inhibition, and shyness in childhood* (pp. 315–341). Chicago, IL: University of Chicago Press.

Parker, J. G., & Asher, S. R. (1987). Peer relations and later personal adjustment: Are low-accepted children at risk? *Psychological Bulletin, 102*, 357–389.

Parker, J. G., & Asher, S. R. (1993). Friendship and friendship quality in middle childhood: Links with peer group acceptance and feelings of loneliness and social dissatisfaction. *Developmental Psychology, 29*, 611–621.

Parkhurst, J. T., & Hopmeyer, A. (1998). Sociometric popularity and peer-perceived popularity: Two distinct dimensions of peer status. *Journal of Early Adolescence, 18*, 125–144.

Patterson, G. R., & Bank, C. L. (1989). Some amplifying mechanisms for pathologic processes in families. In M. R. Gunnar & E. Thelan (Eds.) *Systems and development: The Minnesota symposia on child psychology* (Vol. 22, pp. 167–210). Hillsdale, NJ: Erlbaum.

Patterson, G. R., Bank, C. L., & Stoolmiller, M. (1990). The preadolescent's contributions to disrupted family process. In R. Montemayor, G. R. Adams, & T. P. Gullota (Eds.), *From childhood to adolescence: A transitional period?* (Vol. 2, pp. 107–133). Newbury Park, CA: Sage.

Pervin, L. A. (1983). The stasis and flow of behavior: Toward a theory of goals. In M. M. Page (Ed.), *Personality-current theory and research* (pp. 1–53). Lincoln: University of Nebraska Press.

Phelan, P., Davidson, A. L., & Cao, H. T. (1991). Students' multiple worlds: Negotiating the boundaries of family, peer, and school cultures. *Anthropology and Education Quarterly, 22*, 224–250.

Piaget, J. (1965). *The moral judgment of the child*. New York, NY: Free Press.

Pianta, R. (2006). Classroom management and relationships between children and teachers: Implications for research and practice. In C. Evertson & C. Weinstein (Eds.), *Handbook of classroom management—Research, practice, and contemporary issues* (pp. 685–710). Mahwah, NJ: Erlbaum.

Pianta, R. C., & Stuhlman, M. W. (2004). Teacher-child relationships and children's success in the first years of school. *School Psychology Review, 33*, 444–458.

Peisner-Feinberg, E. S., Burchinal, M. R., Clifford, R. M., Culkin, M. L., Howes, C., Kagan, S. L., & Yazejian, N. (2001). The relation of preschool child-care quality to children's cognitive and social development trajectories through second grade. *Child Development, 72*, 1534–1553.

Reid, M., Landesman, S., Treder, R., & Jaccard, J. (1989). "My family and friends": Six-to twelve-year-old children's perceptions of social support. *Child Development, 60*, 896–910.

Reyna, C., & Weiner, B. (2001). Justice and utility in the classroom: An attributional analysis of the goals of teachers' punishment and intervention strategies. *Journal of Educational Psychology, 93*, 309–319.

Roeser, R., Urdan, T., & Stephens, J. (2009). School as a context of student motivation and achievement. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 381–410). New York, NY: Taylor Francis.

Rose-Krasnor, L. (1997). The nature of social competence: A theoretical review. *Social Development, 6*, 111–135.

Rubin, K. H., Bukowski, W., & Parker, J. G. (1998). Peer interactions, relationships, and groups. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (5th ed., pp. 619–700). New York, NY: Wiley.

Russell, S., Wentzel, K. R., & Donlan, A. (2011). *Teachers' beliefs about the development of teacher-adolescent trust*. Unpublished manuscript, University of Maryland, College Park.

Ryan, A. (2001). The peer group as a context for the development of young adolescent motivation and achievement. *Child Development, 72*, 1135–1150.

Ryan, A. M., & Shim, S. S. (2008). An exploration of young adolescents' social achievement goals and social adjustment in middle school. *Journal of Educational Psychology, 100*, 672–687.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68–78.

Ryan, R. M., Stiller, J. D., & Lynch, J. H. (1994). Representations of relationships to teachers, parents, and friends as predictors of academic motivation and self-esteem. *Journal of Early Adolescence, 14*, 226–249.

Safer, D. J. (1986). Nonpromotion correlates and outcomes at different grade levels. *Journal of Learning Disabilities, 19*, 500–503.

Sanna, J., Simone, V., & Hanna, J. (2010). Research on motivation in collaborative learning: Moving beyond the cognitive-situative divide and combining individual and social processes. *Educational Psychologist, 45*, 15–27.

Sarason, B. R., Sarason, I. G., & Pierce, G. R. (1990). Traditional views of social support and their impact on assessment. In B. R. Sarason, I. G. Sarason, & G. R. Sarason (Eds.), *Social support: An interactional view* (pp. 9–25). New York, NY: Wiley.

Schunk, D. H. (1987). Peer models and children's behavioral change. *Review of Educational Research, 57*, 149–174.

Schunk, D., & Pajares, F. (2009). Self-efficacy theory. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 35–54). New York, NY: Taylor Francis.

Schwartz, D., Dodge, K. A., Pettit, G. S., Bates, J. E., & the Conduct Problems Prevention Research Group. (2000). Friendship as a moderating factor in the pathway between early harsh home environment and later victimization in the peer group. *Developmental Psychology, 36*, 646–662.

Shonkoff, J. P., & Phillips, D. A. (2000). *From neurons to neighborhoods: The science of early childhood development*. Washington, DC: National Academy Press.

Shultz, J., & Florio, S. (1979). Stop and freeze: The negotiation of social and physical space in a kindergarten/first grade classroom. *Anthropology and Education Quarterly, 10*, 166–181.

Sieber, R. T. (1979). Classmates as workmates: Informal peer activity in the elementary school. *Anthropology and Education Quarterly, 10*, 207–235.

Silver, R. B., Measelle, J. R., Armstrong, J. M., & Essex, M. J. (2005). Trajectories of classroom externalizing behavior: Contributions of child characteristics, family characteristics, and the teacher–child relationship during the school transition. *Journal of School Psychology, 43*, 39–60.

Sivan, E. (1986). Motivation in social constructivist theory. *Educational Psychologist, 21*, 209–233.

Slavin, R. (2011). Instruction based on cooperative learning. In R. Mayer & P. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 344–360). New York, NY: Routledge.

Smetana, J., & Bitz, B. (1996). Adolescents' conceptions of teachers' authority and their relations to rule violations in school. *Child Development, 67*, 1153–1172.

Steinberg, L. (2001). We know some things: Parent-adolescent relationships in retrospect and prospect. *Journal of Research on Adolescence, 11*, 1–19.

Sternberg, R. J., & Kolligian, J. (1990). *Competence considered*. New Haven, CT: Yale University Press.

Trenholm, S., & Rose, T. (1981). The compliant communicator: Teacher perceptions of appropriate classroom behavior. *Western Journal of Speech Communication, 45*, 13–26.

Valeski, T. N., & Stipek, D. J. (2001). Young children's feelings about school. *Child Development, 72*, 1198–1213.

Véronneau, Marie-Hélène, & Dishion, T. J. (2011). Middle school friendships and academic achievement in early adolescence: A longitudinal analysis. *Journal of Early Adolescence, 31*, 99–124.

Weinstein, R. S. (2002). *Reaching higher: The power of expectations in schooling*. Cambridge, MA: Harvard University Press.

Weinstein, R. S., Gregory, A., & Strambler, M. J. (2004). Intractable self-fulfilling prophecies: Brown v. Board of Education. *American Psychologist, 59*, 511–520.

Wentzel, K. R. (1989). Adolescent classroom goals, standards for performance, and academic achievement: An interactionist perspective. *Journal of Educational Psychology, 81*, 131–142.

Wentzel, K. R. (1991a). Relations between social competence and academic achievement in early adolescence. *Child Development, 62*, 1066–1078.

Wentzel, K. R. (1991b). Social and academic goals at school: Achievement motivation in context. In M. Maehr & P. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 7, pp. 185–212). Greenwich, CT: JAI.

Wentzel, K. R. (1991c). Social competence at school: Relations between social responsibility and academic achievement. *Review of Educational Research, 61*, 1–24.

Wentzel, K. R. (1993a). Social and academic goals at school: Motivation and achievement in early adolescence. *Journal of Early Adolescence, 13*, 4–20.

Wentzel, K. R. (1993b). Does being good make the grade? Relations between academic and social competence in early adolescence. *Journal of Educational Psychology, 85*, 357–364.

Wentzel, K. R. (1994). Relations of social goal pursuit to social acceptance, classroom behavior, and perceived social support. *Journal of Educational Psychology, 86*, 173–182.

Wentzel, K. R. (1996). Social and academic motivation in middle school: Concurrent and longterm relations to academic effort. *Journal of Early Adolescence, 16*, 390–406.

Wentzel, K. R. (1997). Student motivation in middle school: The role of perceived pedagogical caring. *Journal of Educational Psychology, 89*, 411–419.

Wentzel, K. R. (1998). Social support and adjustment in middle school: The role of parents, teachers, and peers. *Journal of Educational Psychology, 90*, 202–209.

Wentzel, K. R. (2000a). *Teachers' beliefs about pedagogical caring*. Unpublished manuscript, University of Maryland, College Park.

Wentzel, K. R. (2000b). What is it that I'm trying to achieve? Classroom goals from a content perspective. *Contemporary Educational Psychology, 25*, 105–115.

Wentzel, K. R. (2002a). Are effective teachers like good parents? Interpersonal predictors of school adjustment in early adolescence. *Child Development, 73*, 287–301.

Wentzel, K. R. (2002b). The contribution of social goal setting to children's school adjustment. In A. Wigfield & J. Eccles (Ed.), *Development of motivation*. New York, NY: Academic Press.

Wentzel, K. R. (2003). Sociometric status and academic adjustment in middle school: A longitudinal study. *Journal of Early Adolescence, 23*, 5–28.

Wentzel, K. R. (2004). Understanding classroom competence: The role of social-motivational and self-processes. In R. Kail (Ed.), *Advances in child development and behavior* (Vol. 32, pp. 213–241). New York, NY: Elsevier.

Wentzel, K. R. (2005). Peer relationships, motivation, and academic performance at school. In A. Elliot & C. Dweck (Eds.), *Handbook of competence and motivation* (pp. 279–296). New York, NY: Guilford Press.

Wentzel, K. R., & Looney, L. (2007). Socialization in school settings. In J. Grusec & P. Hastings (Eds.), *Handbook of social development* (pp. 382–403). New York, NY: Guilford Press.

Wentzel, K. R. (2009). Students' relationships with teachers as motivational contexts. In K. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 301–322). Mahwah, NJ: LEA.

Wentzel, K. R. (2010). Teacher-student relationships. In J. Meece & J. Eccles (Eds.), *Handbook on schooling and development*. Mahwah, NJ: LEA.

Wentzel, K. R., Baker, S. A., & Russell, S. (2009). Peer relationships and positive adjustment at school. In R. Gillman, S. Huebner, & M. Furlong (Eds.), *Promoting wellness in children and youth: A handbook of positive psychology in the schools* (pp. 229–244). Mahwah, NJ: Erlbaum.

Wentzel, K. R., Barry, C., & Caldwell, K. (2004). Friendships in middle school: Influences on motivation and school adjustment. *Journal of Educational Psychology, 96*, 195–203.

Wentzel, K. R., Battle, A., Russell, S., & Looney, L. (2010). Social supports from teachers and peers as predictors of academic and social motivation. *Contemporary Educational Psychology, 35*, 193–202.

Wentzel, K. R. & Caldwell, K. (1997). Friendships, peer acceptance, and group membership: Relations to academic achievement in middle school. *Child Development*, 1198–1209.

Wentzel, K. R., Russell, S., Garza, E., & Merchant, B. (2011). Understanding the role of social supports in latina/o adolescents' school engagement and achievement. In N. Cabrera, F. Villarruel, & H. Fitzgerald (Eds.), *Volume of Latina/o adolescent psychology and mental health: Vol. 2: Adolescent development*. Santa Barbara, CA: ABC-CLIO.

Wentzel, K. R., Monzo, J., Williams, A. Y., & Tomback, R. M. (2007, April). *Teacher and peer influence on academic motivation in adolescence: A cross-sectional study*. Paper presented at the biennial meeting of the Society for Research in Child Development, Boston, MA.

Wentzel, K., Russell, S. & Baker, S. (2011). *Multiple goals of teachers, parents, and peers as predictors of young adolescents' goals and affective functioning*. Unpublished manuscript, University of Maryland, College Park.

Wentzel, K. R., & Watkins, D. E. (2011). Peer relationships and learning: Implications for instruction. In R. Mayer & P. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 322–343). New York, NY: Routledge.

Wentzel, K. R., Weinberger, D. A., Ford, M. E., & Feldman, S. S. (1990). Academic achievement in preadolescence: The role of motivational, affective, and self-regulatory processes. *Journal of Applied Developmental Psychology, 11*, 179–193.

Wilson, T., Karimpour, R., & Rodkin, P. (2011). African American and European American students' peer groups during early adolescence: Structure, status, and academic achievement. *Journal of Early Adolescence, 31*, 74–98.

Youniss, J., & Smollar, J. (1989). Adolescents' interpersonal relationships In social context. In T. J. Berndt & G. Ladd (Eds.), *Peer relationships in child development* (pp. 300–316). New York, NY: Wiley.

Zimmer-Gembeck, M. J., & Locke, E. M. (2007). The socialization of adolescent coping behaviours: Relationships with families and teachers. *Journal of Adolescence, 30*, 1–16.

Zimmerman, B., & Cleary, T. (2009). Motives to self-regulate learning: A social cognitive account. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 247–264). New York, NY: Taylor Francis.

CHAPTER 11

Early Childhood Education: Improving Outcomes for Young Children and Families

JANE SQUIRES, LOIS PRIBBLE, CHING-I CHEN, AND MARIA POMÉS

It is easier to build strong children than to repair broken men.

—Frederick Douglass

Rich, early experiences; quality, stimulating environments; and sensitive, responsive caregivers lay the foundation for success in learning, school, and life. Brain research, longitudinal risk studies, and investigations of early caregiving environments all point to the critical impact of the early years. Early childhood education is profiled in this chapter, including research findings focused on brain development and early education, highlights of selected successful early childhood program programs, a review of evidence-based models, and a summary of future directions in early childhood, including universal preschool and technology applications in early childhood programs.

EARLY CHILDHOOD EDUCATION

Early childhood education aims to improve the well-being of young children, with a particular emphasis on education and developmental services (www.NAEYC.org, retrieved 3/27/11). Developmentally appropriate practices—those that are focused on the child's developmental status, skill level, everyday activities, and interactions—are the cornerstone of early childhood education. In addition, especially for young children at risk of, or with developmental delays, practices based on scientific evidence that promote effective learning and enhanced outcomes for children and their families are emphasized (www.dec-sped.org). Particular goals of early childhood education include creating developmentally appropriate continuums of learning and development for children, supporting a high-quality and well-compensated early childhood workforce, expanding access for children to high-quality programs in all settings, and promoting collaboration among systems serving young children and families (NAEYC). For those in educational psychology, understanding the early years is critical for understanding the challenges faced by children in their later school grades, and to having the ability to meaningfully intervene and change trajectories later on. In this chapter, we focus on the education of young children from birth through 5 years of age.

Benefits of Education in the Early Years

Much discussion, debate, and research has occurred over the past 50 years regarding the potential benefits of early childhood education. Proponents of early education have long held the premise that intervening early in children's lives makes a difference in their long-term development. Contemporary brain research supports this assertion, providing evidence that education at a young age can impact a child's overall cognitive and behavioral skills (Shonkoff & Phillips, 2000; Thompson, 2009). Early childhood is a crucial time for the brain, a period during which it builds synapses at an extraordinary rate and the foundation for later learning is formed (Thompson, 2009). Brain research indicates that environmental factors play a critical role in the way a child's brain develops (National Scientific Council on the Developing Child, 2007). Good nutrition, consistent and responsive caregiving, and stimulating experiences all contribute to the formation of a solid infrastructure (Rao et al., 2010). On the other hand, negative experiences such as lack of nutrition, abuse, and chronic neglect actually impair the architecture of a developing brain (National Scientific Council on the Developing Child, 2007).

While the human brain continues to develop and change throughout the lifespan, neuroplasticity declines over time. Neuroplasticity, the ability of the brain to change due to experiences, is highest during childhood (Thompson, 2009). As children age, their brain circuits consolidate, forming deeper neural connections based on experience. The consolidation of these circuits makes them more difficult to rewire, suggesting that it is more productive to intervene as they are being formed, rather than later in life (Thompson, 2009). These research findings have impacted public policy, particularly in the development of early childhood programs aimed at children considered to be the most vulnerable for later school failure. Early childhood education has the potential to support healthy brain growth by providing positive child-caregiver relationships, safe learning environments, and stimulating experiences.

Impact of Relationships and Environment on the Brain

Children's brain growth is impacted by the quality of their relationships. During infancy, babies start to build the foundation for emotional regulation as they interact with their caregivers (National Scientific Council on the Developing Child, 2004). Babies whose needs are met through consistent, responsive caregiving thrive. Those whose needs are ignored, or who are exposed to abuse, experience significant alterations in their brain biochemistry (Schore, 2001). The self-regulation skills developed during the early childhood years through interactions with caregivers may well lay the foundation for later school success, health, and job success including level of income (Moffit et al., 2011).

Lack of caregiver responsiveness, coupled with prolonged exposure to high levels of stress, can lead children to experience toxic stress. High levels of stress are linked to a reduced number of cell connections in the brain and can impact growth of the hippocampus (Frodl, Reinhold, Koutsouleris, Reiser, & Meisenzahl, 2010). Toxic stress also can affect the manner in which children react to stress, increasing anxious behavior and impacting their ability to focus their attention on cognitive tasks (National Scientific Council on the Developing Child, 2005).

Some of the most revealing evidence regarding neglect in early childhood comes from studies of young children raised in institutions. Children who spent their early years in institutions have a higher incidence of cognitive delays and behavioral problems, resulting in increased levels of special education placement (Beverly, McGuinness, & Blanton, 2008; O'Connor, Rutter, Beckett, Keavency, & Kreppner, 2000; van IJzendoorn, Luijk, & Juffer, 2008). Brain studies of children adopted from orphanages late in life reveal that long-term changes in the amygdala occur, affecting their ability to regulate emotions (Tottenham et al., 2010). However, intervention can have a significant impact on these children's outcomes. Children who were placed in homes where they received attention and care did better than peers who were left in institutions (Judge, 2003; van IJzendoorn et al., 2008). Importantly, certain factors appear to influence these outcomes. Both the age at which children were removed from institutional care, and their length of stay in the institution affected the amount of developmental improvement (Behen, Helder, Rothermel, Solomon, & Chugani, 2008; Judge, 2003; O'Conner et al., 2000). These findings help support intervening early, assuring children have access to quality relationships and environments as young as possible.

In summary, growing evidence from brain research studies leads the way in defining the importance of early childhood education. Given that early relationships and experiences lay the foundation for building strong brain architecture, early education has a critical role to play. Early education programs can help bolster the home environment, adding to the stimulating interactions and enriching experiences in a child's life. They can also provide nurturing relationships and developmentally appropriate activities for children who lack access to such experiences. Research findings regarding the benefits of early childhood education support the importance of early childhood as a time of great potential and significance in children's development.

History of Early Childhood Education Research: Evidence for Improved Outcomes

Scientific research focused on the benefits of early childhood education began in the 1960s. During this time researchers were specifically interested in figuring out ways to help disadvantaged children obtain better long-term outcomes. Three influential studies arose out of these investigations: the High/Scope Perry Preschool Project, Carolina Abecedarian Program, and Chicago Child-Parent Centers. These longitudinal studies have made a significant contribution to our understanding of early childhood education by providing evidence of both immediate and long-term benefits of such programs for disadvantaged children.

High/Scope Perry Preschool Project

The High/Scope Perry Preschool Project took place between 1962 and 1967 in Ypsilanti, Michigan, and was aimed at providing high-quality preschool for 3- and 4-year-old children born into poverty. One hundred twenty-three African-American children considered high risk for school failure took part in this study (Schweinhart, 2005). Children were randomly assigned to either an early childhood intervention or control group. Preschoolers in the intervention group received 2.5 hours of preschool a day, 5 days a week throughout the school year. Parents took part in facilitated monthly meetings and also received home visits from teachers. Follow-up data on the participants were collected yearly between the ages of 3 to 11 and also at ages 14, 15, 19, 27, and 40. Results indicate that children who attended the preschool program had lower levels of special education placement and higher levels of high school graduation in comparison to children in the control group. As adults they also had higher income levels, lower levels of welfare assistance and arrest rates, and were more likely to own their own homes (Barnett & Belfield, 2006).

Carolina Abecedarian Program

The Carolina Abecedarian Program began in 1972 in Chapel Hill, North Carolina, with 111 children between the ages of 6 weeks and 5 years. The project was created as a way to evaluate whether high-quality early childhood education could ameliorate the effects of high-risk home environments. Children who participated in the study came from households with incomes below 50% of the federal poverty line, had mothers with low levels of education and intellectual attainment, and high levels of unemployment (C. Ramey & Ramey, 2004). Four cohorts of children, born between 1972 and 1977, were included and children were randomly assigned to either an early childhood education intervention or control group. Those in the intervention group took part in a full-day, year-round, high-quality educational program, which consisted of learning game activities focused on social, emotional, cognitive, and language development (C. Ramey & Ramey, 2004). Children were monitored over time to assess individual progress and to compare outcomes between the two groups. Follow-up studies were conducted at ages 12, 15, and 21. Results indicate that children who attended the preschool program had lower levels of special education placement and grade retention, and higher levels of high school graduation and college attendance in comparison to children in the control group.

Chicago Child-Parent Centers

The Chicago Child-Parent Centers (CPCs) are a publically funded school program serving low-income children between the ages of 3 and 9. The Chicago Longitudinal Study is based on data derived from 1,539 children who attended kindergarten in the Chicago Public Schools between 1985 and 1986. Children in the intervention group (989) had attended a CPC preschool program directly before entering kindergarten. Those in the comparison group (550) did not receive CPC intervention and were randomly selected from Chicago Public Schools located in neighborhoods comparable to the one in which the CPCs were located (Conyers, Reynolds, & Ou, 2003). The intervention group attended a half-day preschool program that emphasized school readiness skills, with parent involvement as a core component. Parents were required to participate in the program by attending a minimum of one half-day per week and volunteering in a variety of ways (Conyers et al., 2003). Currently participants have been followed up to age 26. Results indicate that children who attended the preschool program had lower levels of special education placement and grade retention, higher graduation rates, and are less likely to be involved in the justice system.

One of the basic goals of early childhood education is to prepare children to enter kindergarten ready to learn and be successful. Studies indicate that children's literacy and math skill levels in kindergarten are good predictors of how well they will perform at higher grades (Leppanen, Aunola, Niemi, & Nurmi, 2008; Locuniak & Jordan, 2008). Likewise, ratings of negative behavior in kindergarten are highly associated with later behavioral problems (Gagnon, Craig, & Tremblay, 1995; Haapasalo, Tremblay, Boulerice, & Vitaro, 2000). Early childhood programs can greatly impact the readiness skills of preschoolers, both academically and socially. Results from the High/Scope Perry Preschool Program, Carolina Abecedarian Project, and Chicago Parent-Child Center studies indicate that children who attend high-quality early childhood programs have higher language and cognitive abilities when they enter kindergarten (Barnett, 2008; Peisner-Feinberg et al., 2001; C. Ramey & Ramey 2004). Attending early childhood programs can also result in higher levels of appropriate classroom and personal behavior (Peisner-Feinberg et al., 2001).

Enhanced skills and improved relationships resulting from early childhood programs are crucial for children and their families as they enter elementary school. However, societal impact can best be seen in evidence for long-term outcomes. Participation in high-quality early childhood programs affects not only educational achievement but also employment, crime, social welfare, and overall health (Moffit et al., 2011). Longitudinal studies reveal significantly lower special education placement and higher high school graduation rates for children who attend such programs (Conyers et al., 2003). Other positive benefits include less grade repetition and higher college attendance. Closely related to these results are those indicating that children who receive high quality early education are more likely to be employed, have higher earnings, own a home, and have a savings account as adults (Barnett & Belfield, 2006). They are also less likely to be on welfare, become teenage parents, or participate in crimes (Reynolds, Ou, & Topitzes, 2004). Interestingly, children who attended the Chicago Parent-Child Centers, which had an emphasis on parent involvement, were less likely to be victims of child maltreatment or neglect as well (Reynolds et al., 2004).

Cost-Benefit Analysis

With higher employment rates, less crime, and better economic stability for those who participate in early childhood programs, it stands to reason that such programs are an investment well worth making. Following this line of reasoning, several cost-benefit analyses of high-quality preschool programs have been undertaken. These analyses reveal that such programs have one of the most positive economic returns for educational intervention, particularly in comparison to remediation efforts (Temple & Reynolds, 2007). Overall societal gains come from larger tax revenue and lower spending on special education services, the criminal justice system, and welfare payments. Estimates range from a $5.67 to $12.90 return rate for every dollar spent on these programs (Barnett & Masse, 2007; Nores, Belfield, Barnett, & Schweinhart, 2005; Reynolds, Temple, White, Ou, & Robertson, 2011; Temple & Reynolds, 2007). Cost-benefit analyses have been cited in several proposals for increased state and federal support of early childhood programs.

High-Quality Early Childhood Programs

Throughout the past decade, the body of evidence supporting the positive impact of early childhood programs has grown. High-quality early education and intervention are successful and cost effective. Currently, program evaluation efforts focus on which types of programs produce the best results for which types of children. What are the key components necessary to create high-quality preschool environments? Data from longitudinal studies support specific aspects of early childhood programs that impact quality and, in turn, outcomes. The term *high quality* has come to be associated with elements such as highly trained staff, small class size, low staff-child ratios, and systematic evaluation and monitoring of program quality (Barnett, 2003; Espinosa, 2002). Understanding and defining the factors that lead to the best child outcomes is vital as federal and state governments continue to fund, and in some cases expand, early education programs.

PHILOSOPHICAL AND HISTORICAL FOUNDATIONS

Child development is an interdisciplinary concept that refers to biological and psychological maturation processes, beginning at birth and ending in adolescence (Berk, Christensen, & Harris, 2010). Initially, children were considered to be a smaller version of adults; however, it has become apparent that early childhood is a unique developmental phase with complex and rapid physical, cognitive, and emotional changes (Mooney, 2000). This complexity has fostered diverse perspectives to explain the explosion of physical skills and cognitive advances during the first years of life.

As early as medieval times, people began to recognize the vulnerability of young children and identified childhood as a distinct stage of development (Weber, 1984). This attitude toward early childhood helped to shape views in subsequent centuries. In the 16th century, the church underscored the importance of providing education during the early childhood years, and a basic instructional structure was developed. The Enlightenment in the 17th and 18th centuries brought about new philosophical contributions for early childhood education. The debates of whether development is a continuous or discontinuous process (e.g., stage theory or continuous maturational processes) and about the relative influences of nature and nurture started during this period of time.

Charles Darwin (1809–1882) proposed his theory of evolution in the 1800’s, and with this theory highlighted the importance of prenatal growth. Psychologists Stanley Hall (1846–1924) and Arnold Gesell (1880–1961) utilized a normative approach to collect information on each age and stage of child development. They considered early development as a genetically determined process, with children eventually acquiring certain innate skills. At the same period of time, Alfred Binet (1857–1911) created an intelligence test (the English version is the well-known Stanford-Binet Intelligence Scale) in order to capture the complexity of children's thinking and to identify learning problems in children. Binet highlighted individual differences in development, and brought the dimensions of gender, ethnicity, family background, and other demographic characteristics into the development equation.

Theories about child development expanded in the early and mid-20th century. For example, child development was examined from medical, psychological, social, and cultural perspectives. Scientific research methodology was introduced to the field, and human behaviors were considered to be manifest and manipulative associations. Psychoanalytic and psychosocial theorists such as Freud (1856–1939) and Erikson (1902–1994) contributed a stage perspective and the importance of family influences on early development (Nutbrown, Clough, & Selbie, 2008). Behaviorists such as John Watson demonstrated the power of environmental influences on human behaviors and development. Skinner, building on Watson's findings, proposed operant conditioning, a widely applied learning principle in child development. According to Skinner, the frequency of behaviors can be controlled by applying reinforcers (e.g., rewards, toys or foods) and punishments (e.g., withdrawal of preferred items or activities) as consequences of behavior. Bandura added the powerful role of social learning and the role of observational learning, imitation, and modeling in early development (Bandura, 1989).

The cognitive-developmental, or constructivist theory, proposed by Jean Piaget, has become a major foundation of the contemporary field of child development. Through the careful observation of his own children, Piaget observed that children are active learners, following their inner drives and motivations, and acquiring knowledge by actively exploring and experiencing the world. He believed children acquire certain skills corresponding to their stage of development and the external environment, which are grouped together and operate as schemas (Ginsburg & Opper, 1969; Nutbrown et al., 2008). The processes of adaptation, assimilation, and accommodation, are inherent parts of children's learning processes. Between a new idea and existing schema, children use adaptation to reach a balance between mind and environment, and make ongoing efforts to achieve a congruent status of internal structures and the external world.

Similar to Piaget, Vygotsky underscored that children are active learners, but also highlighted the importance of adult and peer support, which assists children in problem solving when encountering new challenges. The concept of the "zone of proximal development" was introduced to explain the distance between the actual developmental level at which children can perform independent problem-solving activities and the level of potential development when adult guidance or peer assistance is required for problem solving (Vygotsky, 1978). Early education should be provided within the zone of proximal development to encourage and advance individual learning experiences, and adult and peer scaffolding all contribute to the unique strengths of the child's culture and learning (Berk et al., 2010; Mahn & John-Steiner, this volume).

Finally, the ecological systems theory, proposed by Bronfenbrenner (1917–2005), describes how children's characteristics interact with environmental factors on multiple levels to develop a complex system of relationships. The environment includes a child as the center for development, and extends to external environments such as daily living surroundings, including family, school, and community settings, which are in a nested structure. Each layer of environment has its own contextual influence on child development, as well as the interactions between layers of the environment (Bronfenbrenner, 1979).

The ecological system emphasizes that environment is dynamic and ever changing. Life events and environmental changes may shape the psychological development of children, and children's reactions and characteristics impact the dynamics in their proximal and distant environments (Bronfenbrenner, 1979). Therefore, both nature and nurture are influential in this theory, and development is seen as an interdependent network of children with their environment (Berk et al., 2010).

Researchers have continued to debate the relative influences of nature and nurture on early development, and whether development is a continuum or occurs in stages, such as theorized by Piaget. Foundations and practices in early childhood education, as well as beliefs and attitudes about young children, were influenced by these theoretical approaches.

In the 20th century, several new theories of development have emerged, influenced by empirical work and the expansion of computer-based models and artificial intelligence. The theories of child development not only improve our understanding of children's characteristics, the inner structure of mind and their cognitive skills, but also help to describe and explain the philosophical orientations of early childhood educational programs. In the next section, selected models of early childhood educational programs are described.

EARLY CHILDHOOD PROGRAMS

Over the years different models of early childhood programs have been developed based on child development theories, early childhood research, and the specific needs and learning styles of young children. Current early childhood models can be categorized into three main types: (1) general, (2) compensatory, and (3) special education.

General Models

General models of early childhood education programs are those that have been developed to serve the preschool population at large. The foundations underlying some models have emerged from a combination of child development theory and research, while others are based on specific theoretical approaches. Following is an overview of four selected general models of early childhood education: Developmentally Appropriate Practice (DAP), Montessori, Reggio Emilia, and Waldorf.

Developmentally Appropriate Practice (DAP)

Within the United States, several theories helped shape an early childhood educational model called developmentally appropriate practice (DAP). DAP is based on the philosophy that teachers need to meet children at their developmental level and assist them in reaching challenging and achievable goals (Copple & Bredekamp, 2009). This approach is supported by brain research studies indicating that a child's brain is open to receiving and retaining information when the child is developmentally ready to absorb the material (Shonkoff & Phillips, 2000). Introducing concepts too early in a child's development can lead to frustration and failure. In contrast, providing children with experiences far below their developmental level can lead to boredom and stagnation in learning. At the heart of DAP is the idea that practitioners can help children be successful by getting to know them and their families well enough to match learning activities to their developmental status and cultural values.

The National Association of Early Childhood (NAEYC) is a professional organization that develops and promotes DAP through guidelines, policies and professional trainings (naeyc.org/DAP). In its work across the United States, NAEYC has helped improve standards for early childhood programs both as an accreditation agency as well as a training and support vehicle. NAEYC oversees national accreditation to early childhood programs that are able to pass a four-stage assessment process demonstrating the use of DAP and other best practices. The five guidelines for developmentally appropriate practice include: (1) creating a caring community of learners; (2) teaching to enhance development and learning; (3) planning appropriate curriculum; (4) assessing children's development and learning; and (5) developing reciprocal relationships with families (Copple & Bredekamp, 2006). Each guideline builds on the creation of an early childhood environment that is supportive of both children and their families and responsive to their individual needs.

Creating a Caring Community of Learners

The classroom climate is an essential component of successful learning. Classrooms that exhibit DAP provide a safe learning space, nurturing relationships, and are inclusive of all children; that is, diversity in abilities, ethnic backgrounds, and family structures is valued and serves as a foundation for learning. Teachers in DAP classrooms are expected to be warm and caring, and to help children learn how to create positive relationships, solve conflicts, and act together as a team. Children's home cultures and languages are valued and represented in the classroom. The physical spaces of DAP classrooms are orderly and clean with predictable routines and schedules that are used to help give children a sense of comfort and ownership. Classroom activities provide a balance of active and quiet time, encourage both independent and cooperative learning, and provide ample time for deep exploration (Copple & Bredekamp, 2006, 2009).

Teaching to Enhance Development and Learning

Teachers who work in DAP classrooms use a wide range of teaching strategies to ensure that they reach all the children under their care; strategies need to be tailored to fit individual needs and learning styles. Teachers scaffold their instruction, making sure that as they challenge children, they also provide appropriate support so children will be successful. A variety of learning formats are used, including large-group, small-group, and one-on-one instruction. Learning centers and routines provide opportunities for children to practice and learn a variety of skills (Copple & Bredekamp, 2006, 2009).

Planning Appropriate Curriculum

The activities and experiences that occur in a classroom are a foundational part of a child's learning, and the classroom curriculum is the vehicle through which knowledge and skills are taught. DAP classroom teachers carefully plan their curriculum and use it to guide the learning of their students and link learning activities to clear goals and outcomes. The DAP curriculum is comprehensive, addressing all major domains of child development, including physical, social, emotional, and cognitive growth. DAP learning in all domains is connected and builds on skills previously taught and mastered (Copple & Bredekamp, 2006, 2009).

Assessing Children's Development and Learning

In order to understand how children's development is progressing, teachers consistently assess their growth and learning. Children's progress is continuously monitored, assuring that children are making gains toward specific learning goals and objectives. Teachers gather data from various sources, including careful observation and documentation of children's activities. Data are collected across times and settings to obtain a fuller picture of children's skills and are then used to guide planning and make classroom modifications when necessary. Any formal assessments used in DAP classrooms are age-appropriate and culturally sensitive (Copple & Bredekamp, 2006, 2009).

Developing Reciprocal Relationships With Families

Families can contribute critical information about their child's interests, learning styles, and preferences; therefore, getting to know a child's family benefits both the teacher and child. Teachers in DAP classrooms strive to develop positive relationships with families, displaying respect and understanding toward family members, acknowledging their important role, and getting to know their cultural values. Communication with families is seen as imperative for making appropriate decisions regarding children; open communication allows teachers and caregivers to provide consistency of care and solve issues as they arise (Copple & Bredekamp, 2006, 2009).

Currently there are more than 6,700 NAEYC accredited programs in the United States, serving over 577,000 children (NAEYC: http://oldweb.naeyc.org/academy/summary/center_summary.asp). The use of DAP, however, extends beyond accredited programs. Numerous preschool programs have been influenced by these practices and apply many DAP strategies at their sites. Further information on DAP can be found at www.naeyc.org/files/naeyc/file/positions/position%20statement%20Web.pdf

The Montessori Method

Maria Montessori (1870–1952), a well-known Italian physician and educator, is the founder of the Montessori Method. She began her work in education in 1900 as the director of an Italian demonstration school for children with special needs. While working in the school she used her keen observation of student behaviors to develop new methods of intervention. Her strategies were so successful in improving students' performance that she began to take a closer look at how these same methods might also be beneficial to students without special needs (Hainstock, 1986).

Montessori's first opportunity to try her methods with typically developing children came in 1907 when she opened Casa dei Bambini, located in the slums of Rome. Montessori was charged with the task of providing a place for children of working mothers to stay while they were away from home. The structure and materials she provided to the children at Casa dei Bambini were the first examples of the distinct components of the Montessori Method, which continue to be used in classrooms today. At Casa dei Bambini, children were given independence in choosing and exploring materials, focusing on those that were of interest to them. The materials were created to be self-correcting so that independence was reinforced and maintained (Hainstock, 1986).

The popularization of the Montessori Method in the United States took place during the 1960s and remains a common approach in early childhood education today. The Montessori Method is based on the idea of the "absorbent mind," a term used to describe young children's ability to spontaneously learn from their environment (Hainstock, 1986). Montessori preschools use a prepared environment to stimulate children's learning, consisting of a quiet, orderly space filled with materials created to meet the child's level and interest. Materials are displayed on open shelves in trays or in baskets, organized in a sequential way to provide a self-correcting structure. A large open space is provided for the children to work within, either on the floor or at tables. Children are viewed as being in charge of their own learning and, therefore, choose the materials that are of interest to them.

Montessori teachers act as facilitators and observers, providing engaging materials but allowing children the freedom and time to explore them independently. Teachers use their observations of individual children to evaluate when a child is ready to be introduced to new materials and activities, modeling how to use materials, as well as the process of choosing activities and returning them to the appropriate space when they are finished (Isaacs, 2007). Montessori classrooms typically provide activities within the domains of practical life, sensory, language, and mathematics, with detail given to their aesthetic and functional qualities. Practical life activities consist of tasks from a child's everyday environment, such as sweeping, pouring, and washing, and children are provided with opportunities throughout their day to practice these skills (Hainstock, 1986; Isaacs, 2007).

Schools that adopt the Montessori framework can either do so independently or become officially certified as Montessori programs. Those considered as official Montessori programs employ teachers who have been trained and receive certificates through specialized Montessori teacher training programs. The Association Montessori International /USA (www.amiusa.org) is an organization that supports Montessori teacher training and school certification within the United States.

Reggio Emilia

Reggio Emilia is a town in Italy that has gained fame due to the educational framework it fosters within its own community. In the 1950s, in postwar Italy, Reggio Emilia began to form a collaborative system of education that promoted deep family involvement, strong local government support, and self-directed learning (Cadwell, 1997). Central to the schools that have evolved from this process is the idea of project learning, where children are able to focus on an area of interest for an extended period of time. Educators from around the world have traveled to Reggio Emilia in Italy to study these schools and have brought these practices back to their own countries. Although it is difficult to replicate the exact program qualities of Reggio Emilia, due to the unique strong community and political support required, classrooms in the United States have used the same core principles to encourage child development and learning.

Eight fundamental aspects of the Reggio Emilia approach include: (1) the child as protagonist, (2) the child as collaborator, (3) the child as communicator, (4) the environment as the third teacher, (5) the teacher as nurturer and guide, (6) the teacher as researcher, (7) documentation as communication, and (8) the parent as partner (Cadwell, 1997). Each is described further on. As a protagonist, Reggio Emilia philosophy sees children as capable participants in their own learning. Children are encouraged to be involved in the educational process, allowed to make choices about their activities and give input to teachers. Projects are developed and led by child interests.

Second, as collaborators, children are seen as interconnected to those in their lives, including their families, teachers, and classmates. Interaction with the people and materials in the environment are viewed as the process by which children develop, and children often work collaboratively in small groups.

Symbolic representation is the mechanism by which children communicate, according to Reggio Emilia. Ample materials are provided for children to express themselves through words, movement, drama, art, music, and play. The resulting activities and products are viewed as the language through which children communicate their understanding, thoughts, and questions.

Fourth, Reggio Emilia views the environment as a third teacher. The classroom space is engineered to encourage interactions and help build relationships. Therefore, the environment needs to be carefully planned and organized, with each space having a purpose. Classrooms in Reggio Emilia schools are set up with attention to detail, providing both order and beauty.

Teachers in Reggio Emilia schools act as interactive facilitators, assisting children in bringing their ideas and work to fruition. They provide opportunities for children to work on both short-term and long-term projects and help them with problem solving along the way. Teachers are actively engaged with children and encourage their thinking by asking questions and helping children form their own hypotheses about learning activities.

Sixth, teachers work collaboratively to document the ongoing work of the children, conducting research in their classrooms. They talk and discuss with children and with one another the meaning of the work that is occurring. Teachers are reflective of their own practices as well as the experiences of their students.

Seventh, each day teachers present the classroom process through documentation. They write down the purpose and intention behind projects, transcribe what children are saying, take pictures as students are engaged in activities, and collect products along the way. These materials are used to represent and explore the learning that has occurred in the classroom. Documentation is posted throughout the school so that children, teachers, family members, and community members are given a chance to reflect and explore on the experiences and facilitate the exchange of ideas and continued learning.

Finally, family participation is an essential element of learning. Families are encouraged to participate in a variety of ways, including helping out in the classroom. Family members lend their own skills and ideas to the learning process and are viewed as advocates for their children. Teachers communicate consistently with families to gain insight and create a process of sharing and trust (Cadwell, 1997; Kinney & Wharton, 2008). Many early childhood programs within the United States have adopted approaches used in Reggio Emilia. Its philosophies are taught within teacher training programs and numerous educators have visited, and continue to visit, this town in Italy to observe and study the implementation of their practices. Organizations such as the North American Reggio Emilia Alliance (reggioalliance.org) have also been formed to support the ongoing exploration of using this approach in the United States.

Waldorf Education

The Waldorf model of early childhood education is based on the work of the Austrian philosopher-educator Rudolph Steiner (1861–1925). Steiner formed the first Waldorf school in Germany in 1919, focusing on the belief that children develop in three distinct stages: early childhood, middle childhood, and adolescence (Barnes, 1991). Steiner saw early childhood as the time when children explore the world through their senses and imitation. He believed it was the caregiver's responsibility to create an environment filled with appropriate sensory stimulation and opportunities for positive imitation (Barnes). Modern-day Waldorf schools follow this same basic philosophy.

Waldorf teachers pay special attention to both materials and activities. Classrooms are created to reflect a home-like space, resulting in a sense of security and belonging. The classroom environment is made up of natural materials, including wooden furniture and toys, silk fabrics, felted crafts, and cloth dolls. Objects from nature such as shells, stones, pinecones and sticks are also incorporated. Materials are open-ended, with the ability to be used in many ways, in order to encourage creativity and exploration (Barnes, 1991; Petrash, 2002).

Waldorf early childhood classrooms focus on practical and creative activities, giving many opportunities for imitation. Teachers lead the children in experiences such as cooking, gardening, painting, and craft making. Activities are linked to the current season and connected to the natural world. The classroom day also allows for extended periods of play and storytelling. The use of children's imagination is emphasized and built upon (Barnes, 1991). Waldorf emphasizes the use of multiple intelligences; so rhythmic activities, poem recitation, and movement exercises are incorporated into the daily routine to foster language and motor skills (Petrash, 2002).

The Association of Waldorf Schools of North American (whywaldorfworks.org) links Waldorf schools across the United States and provides information to families and teachers interested in this methodology. There are also several training programs within the United States that educate professionals to become Waldorf teachers.

Compensatory Models

Compensatory early childhood programs refer to those that serve children considered at-risk for later academic failure. Typically, compensatory programs in the United States focus on children living in poverty. Poverty has been shown to be a significant factor in academic achievement, with children of lower socioeconomic status more likely to perform poorly in school, less likely to graduate, and less likely to attend college (Rowan-Kenyon, 2007; South, Baumer, & Lutz, 2003; Tajalli & Opheim, 2005). The National Center for Children Living in Poverty (NCCLP) states that there are currently more than 15 million children living in poverty within the United States of America (Wight, Chau, & Aratani, 2011). Compensatory programs, therefore, play a vital role in the early education of young children.

Head Start

Head Start is perhaps the best-known and widest reaching compensatory early childhood program in the United States. It began in 1965 as part of President Lyndon Johnson's War on Poverty with the goal of leveling the educational playing field for children from economically disadvantaged families. During that time, early childhood advocates noted that children living in poverty came to school already lagging behind their peers in academic readiness. This gap in achievement continued as children went through school, with children from impoverished backgrounds falling farther behind. Head Start was developed as a way to ameliorate the effects of poverty on children's school readiness, giving them equal opportunity in schooling and later life. Federal funds were used to develop free preschool programs to support the academic growth, social skills, and health of these young children. Today, more than 45 years later, Head Start programs still exist in every state in the United States and currently serve more than 900,000 children (U.S. Department of Health & Human Services, 2010b). In order to qualify for Head Start services, children must be between the ages of 3 and 5 and come from families that live at or below the federal poverty line ($22,350 for a family of four in 2011).

The Office of Head Start (www.acf.hhs.gov/programs/ohs/) describes its goal as providing children with "a safe, nurturing, engaging, enjoyable, and secure learning environment, in order to help them gain the awareness, skills, and confidence necessary to succeed in their present environment, and to deal with later responsibilities in school and in life" (Office of Head Start, 2010). The program is based on the principle of developing the "whole child." This includes providing comprehensive services aimed not only at improving academic achievement, but social skills, nutrition, and physical health as well. Head Start programs provide center-based preschool classrooms that implement curricula focused on teaching literacy, math, and social skills. Nutritional meals are provided to children, and physical activities are incorporated into the daily schedule; parents are given resources regarding parenting practices and access to local social services. This emphasis on the whole child has translated into improved outcomes for attendees of Head Start programs. Research indicates that, along with academic gains, children who attend Head Start show a decrease in problem behavior, exhibit better social skills and have improved dental and physical wellness (Gormley, Phillips, Adelstein, & Shaw, 2010; U.S. Department of Health and Human Services, 2010a). Research indicates an effect on parental practices as well, including a decreased use of punitive discipline and increase in reading practices (Puma et al.).

Early Head Start

Early Head Start began in 1995 as an outgrowth of the Head Start preschool programs. This community-based program provides services to pregnant women, infants, and toddlers living in poverty. As the name implies, the aim of Early Head Start is to impact children's lives as soon as possible rather than waiting until they enter preschool. The mission of Early Head Start is to: (1) promote healthy prenatal outcomes for pregnant women, (2) enhance the development of very young children, and (3) promote healthy family functioning (Early Head Start National Resource Center [EHS NRC], 2010). These goals are accomplished through programs that focus on both child and family development. Services include childcare, parent education, job skills training, comprehensive health and mental health services, and case management (EHS NRC, 2010). Services are delivered in a variety of ways including home-visiting, center-based classrooms, and referrals to existing community services. A key component to Early Head Start programs is parent involvement, with emphasis placed on the role and responsibilities of parents in their children's development. Services focus on helping parents gain the information and skills needed to raise their children in safe, healthy, and stimulating environments.

Special Education Models

The Individuals with Disabilities Education Act (IDEA) is national legislation that specifies regulations, requirements, and guidelines for special education services. Children are served free of charge in special education programs if they meet eligibility requirements for having a disability, as stated under IDEA. Part C addresses how early intervention (EI) services should be provided for young children age birth to 3 years, and Part B, Section 619, delineates early childhood special education (ECSE) services for children age 3 through 5 years. Under Part C, families are required to be included in the entire service delivery process, and EI services are provided in natural environments such as homes and childcare centers. Part B also emphasizes the importance of children receiving services with typically developing children. When providing services to children and families under IDEA, professionals must consider the "who," "how," "when," and "where" when selecting appropriate models.

Who

Services in the field of EI/ECSE are family-centered and child-focused. Interventions target the enhancement of children's development and support caregiver needs in order to promote positive outcomes for both children and families. Family involvement is mandated in IDEA and professionals are encouraged to optimize opportunities to include caregivers in every step of service delivery.

How

In EI/ECSE, a teaming model is widely adopted to provide services to children and their families. IDEA mandates collaboration between families and professionals. Intervention practices addressing children's needs should be implemented with efforts from multidisciplinary professionals. Three major collaborative team models in EI/ECSE include: (1) multidisciplinary, (2) interdisciplinary, and (3) transdisciplinary.

The *multidisciplinary model* evolved from the unidisciplinary medical model. Professionals with different expertise independently work with children. Strategies for remediating developmental disabilities are given to parents by professionals. In this model, the child receiving services is the focus. Nonetheless, limited communication and information sharing occur in this model, and caregivers often receive duplicative or confusing information. In the *interdisciplinary model*, professionals make group decisions based on information sharing and strategy exchange. However, the actual implementation of services is still based on the individual service provider. The *transdisciplinary model* includes professionals in every process of service delivery as professionals share roles across boundaries. Team members work as a unit to administer assessments, select goals, and share intervention strategies with families. A service provider coordinates services and serves as a liaison with families. Families are included in the decision-making process.

Even though all three teaming models are utilized within EI/ECSE, the transdisciplinary model is highly recommended because (a) it is family-centered; (b) it maximizes family involvement in service delivery; and (c) professionals empower other team members by sharing assessment and intervention strategies (Briggs, 1997). Nonetheless, professionals should select the appropriate teaming model based on family priorities and concerns, existing resources and team characteristics to establish a collaborative and supportive relationship (Blasco, 2001; Raver, 2009; Sandall, Hemmeter, Smith, & McLean, 2005).

When and Where

The "when" and "where" are two important factors that determine service delivery models. EI/ECSE include four main models: home-based, center-based, home-center, and itinerant teacher in inclusive preschool settings.

Home-Based Program Model

The home-based service delivery model is used primarily with infants and toddlers and their families. In this model, EI professionals visit the family at regular intervals, and interventions are implemented in the home environment. The professional may work directly with children on their goals and objectives with caregiver assistance, after modeling the strategies for caregivers (Raver, 2009). Professionals also target establishing positive interactions and attachments between children and their caregivers. DEC recommended practices (Sandall et al., 2005) suggest that the home-based program model should: (a) embed teaching opportunities in daily family routines, (b) maximize the involvement of family members, and (c) organize the frequency and intensity of services according to child and family needs. Following these guidelines, professionals should consult with caregivers about family routines in order to embed contextual learning moments into these routines, as well as to increase the feasibility of intervention practices for caregivers (Pretti-Frontczak & Bricker, 2004). Home visitors should be caring, respectful, and relaxed, and maintain professional behaviors and confidentiality when working with families (Korfmacher et al., 2008). It is also important to build rapport with caregivers and recognize their expertise when working with their children.

Even though this service model may limit children's opportunities for peer social interaction, and for the provision of interdisciplinary services, there are several advantages of a home-based model. Children and families can benefit from strong, collaborative relationships with professionals, as well as the concentrated time frame, service flexibility, and continuous family involvement afforded by home based programs (Blasco, 2001; Korfmacher et al., 2008; Sandall et al., 2005).

Center-Based Program Model

This model is usually used with preschool children and is more child-focused, when compared to home-based programs. In a center-based program model, professionals from multiple disciplines provide services directly to groups of children in one central location. The intensity and frequency of services are determined not only by child and family needs, but also depend upon program resources and the number of staff (Raver, 2009). Centers usually have a predetermined but flexible daily schedule of classroom activities, and offer regular caregiver training and professional development opportunities. In this model, children have more opportunities to explore and interact with peers while receiving intervention services, and their caregivers also are more likely to meet other parents and receive parent-to-parent support. DEC recommended practices (Sandall et al., 2005) suggest that center-based classrooms should: (a) provide a safe and hazard-free environment that promotes self-exploration and active learning; (b) have adequate staff-child ratios that contribute to a safe and healthy environment, as well as effective intervention practices; (c) provide age and developmentally appropriate toys; (d) encourage services from other disciplines (e.g., speech language therapy, physical, and occupational therapy) that are provided during regular classroom routines rather than during pull-out services; (e) provide classroom activities that embed optimal learning opportunities; and (f) encourage collaboration from multiple disciplines.

Center-based programs provide a consistent and safe place for both children and families to receive services.

Children are given opportunities to gain important developmental skills, as well as to learn and practice their social skills. Parents often receive support from other parents during parent meetings and parent-child classroom times. However, in center-based programs, it can be more difficult to tailor interventions to the needs of individual families when compared to home-based models. In addition, the limited social skills of children with special needs may limit their interactions with typically developing peers in classroom-based settings and often require targeted social interventions (Guralnick, Connor, Hammond, Gottman, & Kinnish, 1996; Odom, 1998, 2000; Raver, 2009).

Home-Center Program Model

The home-center program model is a combination of the previous two service models. Ongoing center-based services are concurrently provided with home visits. This service delivery model is often used when there are financial and geographical circumstances that make this combined model more advantageous. This combination model is adopted to optimize opportunities for children to receive services, to increase social opportunities for children, and to access support for families. It can also provide a smooth transition between home-based and center-based models for young children and their families.

Itinerant Teacher/Inclusion Model

In this model, an EI/ECSE professional serves as an inclusion specialist who provides direct and indirect services to children with special needs and their families. The itinerant EI/ECSE teacher may directly work on children's learning goals and objectives within classroom routines, or provide indirect services such as working with another professional to better include children with disabilities in classroom activities (Harris & Klein, 2002, 2004). Itinerant teachers may also serve as a supportive resource by providing technical assistance and consultation and training to early childhood classroom teachers on EI/ECSE related topics (e.g., teaching, parent communication, and environmental adaptation strategies).

These models are frequently implemented in EI/ECSE with varying advantages and limitations. When making placement decisions, the evaluation team should consider assessment results, children's current level of development, family concerns, and examine how the possible benefits and limitations of each program may contribute to child outcomes. By providing services to children using the appropriate model, children will have optimal learning opportunities and benefit from the interventions (Raver, 2009; Sandall et al., 2005).

EVIDENCE-BASED EARLY INTERVENTION APPROACHES

The field of education as a whole has become increasingly focused on making sure that educational services are delivered in ways that are effective. Demands to provide high quality educational services and achieve positive outcomes for children are present across all levels of early childhood education. In 2002, President Bush announced the No Child Left Behind (NCLB) Act in order to support setting high standards and establishing measureable goals to improve educational outcomes. As part of this process, NCLB also required teachers to use evidence-based practices with children. President Obama followed with his own initiative, Race to the Top, that also required use of evidence-based models. The term *evidence-based* refers to strategies supported by scientifically based research. Two evidence-based models are being emphasized within the field of early childhood education: response to intervention and the linked system model.

Response to Intervention (RtI)/Recognition and Response (R&R)

The increased number of children that are served by the preschool system, and the growing accountability demands on early childhood educators have resulted in the necessity of rethinking models and professional roles in order to offer meaningful learning experiences and timely support for all children (Coleman, Buysse, & Neitzel, 2006; Jackson, Pretti-Frontczak, Harjusola-Webb, Grishman-Brown, & Romani, 2009; VanderHeyDen & Snyder, 2006; Walker, Carta, Greenwood, & Buzhardt, 2008). Multitiered systems appear to be an effective framework to provide appropriate developmental opportunities for all children, offering adjusted levels of instruction and progress monitoring to guide responses to students' needs (Fox, Carta, Strain, Dunlap, & Hemmeter, 2010). *Response to Intervention (RtI)* is a widely used multitiered framework for school-age children designed to prevent learning delays and challenging behaviors (e.g., Coleman et al., 2006; Fuchs, 2003; Fuchs, Mock, Morgan, & Young, 2003; Justice, 2006). In early childhood education, one RtI model is known as *Recognition and Response* (R&R), formulated to provide high-quality instruction and meet young children's learning needs.

Researchers who develop and implement multitiered models of prevention for young children largely agree on which features should be incorporated into RtI at the preschool level. The current body of research on multitiered approaches at the preschool level describes core elements such as: (a) the necessity of including scientifically validated interventions and developmentally appropriate practices that also respond to children's cultural values; (b) universal screening oriented to identify typically developing children and children who might be at risk for delays; (c) continuous progress monitoring using systematic assessment to guide decisions and indicate the intensity of instructional support that match children's needs; (d) parent involvement in the decision-making process and learning activities that meet family expectations; and (e) continuous evaluation of intervention fidelity to document how procedures were implemented across different stages of the intervention model (e.g., Barnett, VanDerHeyden & Witt, 2007; Bruder, 2010; Fox et al., 2010; Jackson et al., 2009).

The RtI model for preschoolers helps professionals identify children's needs and services in an effective, timely hierarchical approach (Coleman et al., 2006). RtI usually adopts a pyramid model of three tiers to represent the intensity of the required intervention. Tier 1 corresponds to universal or primary prevention, and regularly benefits 80% to 90% of children. At this level, a rich family environment and predictable routines should be provided to offer meaningful learning opportunities for all children. Tier 1 facilitates and supports positive and nurturing parent-child interactions as a relevant strategy to promote growth and full development of child's potential. Tier 1 also emphasizes collaborative teamwork among professionals and family members. Practitioners at this level are encouraged to deliver their interventions from a family-centered approach to ensure family involvement and active participation within the community (Bruder, 2010). Parent collaboration models require professionals to recognize all aspects of family life, and to consider parents' priorities, concerns and cultural beliefs in order to empower the family (Bruckman & Blanton, 2003). Parents and professionals should view each other as partners, sharing their expertise that will help the family to achieve its goals (Dinnebeil, Hale, & Hale, 1996; Soodak & Erwin, 1995). Parents' knowledge and child rearing philosophy need to be considered.

Primary prevention can also take place in the preschool or childcare setting. This level of prevention requires the design of significant and high quality educational services and the incorporation of evidence-based practices. Developmentally and culturally appropriate curriculum should be implemented (Fox et al., 2010). Goals should also be embedded within children's routine and familiar environment (Bradley, Danielson, & Doolittle, 2007).

Tier 2 constitutes the secondary level of prevention and it is oriented to provide more intensive and systematic support for children who have demonstrated insufficient progress at the previous level. Usually 10 to 15% of children require this level of support. Family involvement in the decision-making process is a core feature at this secondary prevention level. Curriculum adaptations, minimum adjustments of classrooms routines, environmental arrangements in the classroom, and explicit schedules are suggested to targeted groups of children who require additional support (Coleman et al., 2006; Squires, 2010).

Tertiary prevention is represented by the third tier in the pyramid model. Tier 3 requires individualized and intensive support for children who have not been responsive to previous instructional strategies based on the information gathered by continuous progress monitoring. At this level, children are expected to develop social competence and pre-academic skills that allow them to fully participate later at school level. An educational approach that provides services in an inclusive and natural environment should be provided at this level. Family participation and team collaboration should also be included to make relevant decisions and promote adequate child development. Children who do not progress as expected way might need to be referred for formal assessment to determine eligibility for special education services (e.g., Barnett et al., 2007; Coleman et al., 2006; Fox et al., 2010; Walker et al., 2008) in a typical early childhood environment.

Thus, the multitiered model of prevention should ameliorate the impact of risk factors that can result in disabilities or developmental delays for young children by providing high quality interventions and effectively responding to children's varying needs. The ultimate aim is to decrease the intensity of the intervention and gradually withdraw individualized assistance to promote a positive and sustained trend of growth (Barnett et al., 2007).

Benefits and Challenges of Using RtI in Preschool Settings

Although RtI seems to be a promising alternative to identify and support young children who are experiencing learning challenges, its application at the preschool level has been limited, possibly due to the complexity of the model and the multiple variables associated with its implementation and evaluation. Following is an overview of some of the benefits and challenges of implementing this model in early childhood.

Benefits of Applying RtI

Several benefits of applying the RtI framework at the preschool level are possible to achieve according to the evidence previously described.

Promotion of Children's Growth Based on Validated Practices

Preschool children can benefit when they receive intervention practices that are scientifically validated and developmentally appropriate. The use of evidence-based practices is an effective strategy to promote services that can be associated with positive outcomes for young children and their families (Bruder, 2010). The utilization of valid practices in preschool settings will allow professionals to apply rigorous and systematic programs that can be monitored during their implementation and to pursue predetermined and adjusted goals.

Larger Number of Children Can Have Access to Universal Prevention

RtI promotes the use of universal screening as a gate of access to the hierarchical pyramid of prevention options. Screening is used for early identification of children who may or may not be making the expected progress in achieving milestones in all different developmental domains. Based on screening results, it is possible to recognize those children who require additional assessment (e.g., Snyder, Wixson, Talapatra, & Roach, 2008; Squires, 2010) and more intensive interventions.

Family Empowerment

IDEA and recommended practices for intervening with young children emphasize the importance of inclusion of parents and family members. Family and primary caregivers make essential contributions to the collaborative efforts to provide development opportunities and enriched learning environments. In addition, parents are able to identify early signs about their child's growth and whether or not their child is progressing in an expected way (Coleman et al., 2006); therefore, family participation is a central component in the decision making process ensuring accurate descriptions of the child's development, embracing family priorities, and establishing meaningful goals (Bayat, Mindes, & Covitt, 2010). Thus, RtI can offer opportunities for family participation and facilitate parent involvement.

Informed Transitions

Trajectories of children's developmental progress can be enhanced, based on the systematic and valid evidence gathered from continuous progress monitoring. The developmental process that every child is experiencing and the way in which every child is performing in response to a specific intervention can be constantly evaluated (VanDerHeyden & Snyder, 2006). Responding to the magnitude of their progress, children can receive appropriate and individualized intensity of services and can transition from one level of prevention to another in an efficient manner.

Enhanced Sensitivity and Specificity of Screening Process

A precise identification process for children who might be recognized as eligible or ineligible for specialized services is highly recommended in order to provide adequate interventions (Bricker et al., 2008). Using valid assessment in a comprehensive and systematic framework, RtI can accurately identify young children with disabilities and facilitate their timely access to EI/ECSE services.

Promotion of School Readiness

Optimizing developmental and learning opportunities and minimizing the number of young children who are at risk for disability or developmental delays are effective ways to promote children's willingness to learn and facilitate their movement toward advanced levels of development (Hojnoski & Missal, 2010). At the same time, preschool settings applying the RtI model are often more prepared to receive and support children with diverse needs and unique characteristics.

Challenges of Implementing RtI in Preschool

The implementation of new models and practices undoubtedly brings a complex scenario for stakeholders and all the organizational structures involved in this process (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005). In order to facilitate a feasible, effective, and smooth transition toward implementation of this new system, challenges need to be addressed. Following are some of the current challenges involved in implementing RtI at the preschool level.

Increasing Coverage of Primary Prevention

Early intervention historically has served children at risk for disabilities and children with special needs, but there are arguments for increasing access to early education for all children (VanDerHeyden & Snyder, 2006). An effective system of prevention should support all children at a young age. Thus, primary prevention can optimize the detection of delays in a timely manner. Currently, only young children who are attending preschool or in a child-care system may have access to screening and early educational services. Expanding the coverage of high-quality primary prevention strategies should be considered to increase prevention opportunities for young children.

Conceptual Alignment

There is a need for clarification and agreement on how principle features of RtI are defined and operationalized. The boundaries among tiers and the actions accomplished in each level are not always consistent. For instance, there are different approaches of situating special education services in the RtI framework. One trend includes special education in the last tier of the pyramid model, and other approaches consider special education service as a different level outside of the prevention model for children who have not been successful at the preceding levels (Fuchs, Fuchs, & Stecker, 2010). In a preschool context, it is important to define and clarify the goals and proper activities for each tier in order to deliver effective services.

Economical Support and Coordination

Resources are an important aspect to be considered before adopting a new model such as RtI. Concerns about the effectiveness of early educational services have been discussed in reports such as the performance plan for evaluating state implementation of Part B, section 619 (U.S. Department of Education, 2009). One possible explanation for lack of effectiveness data in early childhood is the difficulty of providers to implement practices that are proposed by the law and recommended by research (Bruder, 2010). The lack of financial support is another difficulty for implementation and sustainment of new practices and models. Even though practices are implemented with fidelity and continuous monitoring, the effective coordination of services is still an important concern. How to centralize the distribution of information, guidelines, materials, and organizational procedures and how to provide coordinated prevention services for children at a young age where simultaneous programs are implemented provide additional challenges. These are elements that need to be articulated for a successful implementation of RtI model in preschool level.

Professional Development

High-quality preservice and inservice training opportunities are essential tools for improving the quality of educational services. Professionals, who will be part of the decision-making process, should be prepared to assume a variety of roles in a context that is constantly changing. Currently, there are different program alternatives for preservice teacher preparation across the United States. Positive and collaborative interactions among special education and general education departments are beneficial as preservice teachers enter educational systems that are undertaking RtI delivery models (Harvey, Yssel, Bauserman, & Merbler, 2010). Teachers working in preschool programs must be skilled in collaboration, designing development plans, and interacting with culturally diverse families on empowerment (Conderman & Johnston-Rodriguez, 2009). Thus, teacher-training institutions have the responsibility to ensure that all teachers are well trained and offer ongoing high-quality professional development opportunities based on empirical and developmentally appropriate practices.

Support Implementation and Ensure Sustainability

An appropriate infrastructure and adequate capacity to sustain changes will be needed in order to adopt and maintain a new system. Continuous, ongoing monitoring to ensure fidelity of implementation is a crucial aspect for program effectiveness (Coleman et al., 2006; VanDerHeyden & Snyder, 2006). Programs will need to be carefully organized, data-based, and prepared to meet internal and external challenges in order to maintain effectiveness regardless of contextual changes (Fixsen et al., 2005).

The adoption and implementation of the RtI framework at the preschool level is a promising alternative to enhance children's developmental opportunities and the quality of services delivered for children at a young age and their families. Early intervention and early childhood special education have historically integrated the specific needs of young children and the participation of families in their educational practices. These features can be strengthened by implementing the RtI model that promotes the use of evidence-based practices and a problem solving approach. Effective multitiered systems offer the promise of improved developmental and academic outcomes that will benefit young children and their families in early childhood settings.

A Framework for a Linked, Comprehensive Early Education System

The three-tier RtI model can be situated in a larger linked system framework appropriate for early childhood settings (Bricker, 1989; Pretti-Frontczak & Bricker, 2004). The linked system model, presented in Figure 11.1, is composed of five distinct processes: screening, assessment, goal development, intervention, and ongoing evaluation. Although these five processes are distinct, the information

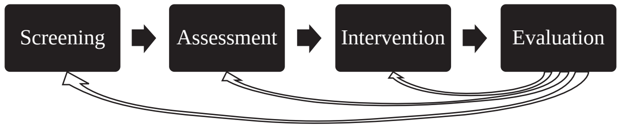


Figure 11.1 Linked system model in early childhood

generated by each process is directly related or relevant to the subsequent process. That is, screening outcomes are relevant to the assessment process, and outcomes from assessments are directly relevant to goal development. In turn, goal development drives intervention efforts, and finally, the evaluation process is critical in determining the effectiveness of the previous assessment, goal development, and intervention processes. This framework is appropriate for targeting developmental and cognitive competence in young children in home and center-based settings (Squires & Bricker, 2007).

The first process, screening, is a brief, formal evaluation of developmental skills intended to identify those children with potential problems who should be referred for a more in-depth assessment (Squires, Twombly, Bricker, & Potter, 2009). Screening instruments are usually quick, are easy to administer, and should yield valid and reliable results. Empirical evidence supports the need for ongoing developmental and behavioral screening conducted at repeated intervals in order to identify problems as soon as they are apparent and to implement interventions at the earliest time possible (American Academy of Pediatrics, 2001, 2006; Committee on Pediatric Workforce, 2011; Squires, Nickel, & Eisert, 1996). Through universal screening and identification, developmental problems can be prevented before they become ingrained in young children's behavioral patterns (Walker, Severson, & Seeley, 2010). Screening is suggested in environments such as child-care centers, preschool classes, day-care programs, and home visiting programs. Simple screening tools, often completed by parents, can be administered at minimal cost and with the valuable input of caregivers (Squires et al., 2009).

Children whose screening results indicate potential developmental problems can be referred to a specialist for an in-depth assessment to determine eligibility for early intervention, early childhood special education, or mental health services. Prevention activities targeting developmental and behavioral needs can be given to parents and to classroom teachers to support developmental outcomes in children who do not qualify for specialized services. Activities targeting low-skill areas such as fine motor (e.g., drawing, experience with crayons/pencils) and communication (e.g., listening to simple stories, repeating back what happened) are examples of follow-up activities based on screening results.

The assessment process in this linked system model is designed to produce outcomes that are directly applicable to the development of early childhood intervention goals and content for children and caregivers. A curriculum-based or curriculum-embedded assessment is suggested for this process, and should be one with established validity and reliability. Examples include the Creative Curriculum (Dodge, Colker, & Barrett, 1992), High/Scope (HighScope Educational Research Foundation, 1992); Assessment, Evaluation, and Programming System (AEPS; Bricker, 2002): and the Carolina Curriculum for Infant and Toddlers with Special Needs (Johnson-Martin, Hacker, & Attermeier, 2004a) and Carolina Curriculum for Preschoolers with Special Needs (Johnson-Martin et al., 2004b). These curriculum-based assessments (CBAs) are composed of items that have associated criteria or examples, and curriculum activities. For example, on the AEPS, items in the social area include the following: "Responds to communication with familiar adult" (Level I: Birth to Three Years); "Joins in cooperative activity" and "Negotiates to solve conflict" (Level II: Three to Six Years). By using published CBAs with established validity and reliability, a more effective and targeted teaching approach often results, with children's developmental needs identified through an assessment process, followed by targeting of curricular activities focused on these specific needs.

Following screening and assessment, goal development is the next process in this linked system model. Results from the CBA should be used to develop goals for the child. With the assistance of caregivers or family, the CBA results can be reviewed, and the child's strengths and needs, as well as caregiver concerns, can be identified. By reviewing the CBA and soliciting caregiver input, intervention goals can be identified that are functional and useful for the child across settings.

The fifth and final process in the linked system approach is evaluation. Two types of evaluation are necessary for effective intervention: (1) ongoing monitoring of progress toward individual child goals (usually selected from the CBA); and (2) assessment of the overall program impact on participating children and families. Progress may be monitored daily, weekly, or monthly to determine if intervention strategies are providing appropriate and sufficient learning opportunities to attain the targeted skills. Assessing overall program impact requires data gathering for quarterly and annual evaluation, which is often more global than when monitoring individual child progress. Two different kinds of evaluation measures can be used for monitoring child progress toward goals–critical skills mastery using CBAs and general outcome measures (GOMs), in which key skills are identified and probed over time, such as picture naming, rhyming, and alliteration (Hemmeter, Joseph, Smith, & Sandall, 2001).

The linked system provides an effective and efficient means for providing early childhood educational services, especially for programs serving children at risk for, and with developmental disabilities (Bagnato, Neisworth, & Pretti-Frontczak, 2010). While not all early childhood programs will need to provide such an extensive structure for provision of their educational programs, both the RtI and linked system models allow for systematic, data-driven approaches that have the potential to assure success for all children and to identify those who may be having difficulties at the earliest point in time (Squires, 2010).

FUTURE DIRECTIONS

Just as all fields of educational psychology continue to evolve, so does the field of early childhood education. Medical research, the political climate, and ongoing educational studies all influence the direction of early childhood programs. The following section proposed two areas that promise to have an important future impact on early education within the United States. The first concerns the importance of access for all children to universal preschool programs. The second pertains to the application of technology in early childhood.

Universal Preschool

Universal preschool refers to early education programs funded by state and federal governments and open to all preschool children regardless of family income level. This educational concept was first introduced in the 1990s when public interest in early childhood brain research and in findings about the positive impact of early education began to expand. State legislators acted on this interest and passed legislation to fund the first versions of universal preschool, based on the belief that making public preschool available to all children would reach a wider population and lead to better academic and social outcomes, and ultimately an improved state economy. Previously, only targeted approaches to government-funded preschool programs had been taken, with programs such as Head Start aimed at reaching children in the most at-risk populations. Legislators who advocated universal models in their states felt that early education programs available to the entire population, rather than specific families, would garner more support and, in turn, lead to better funded and higher quality programs for children (Rose, 2010). Throughout the years, education reform advocates, private foundations, and business leaders have taken an interest in universal preschool initiatives and worked to expand them (Rose, 2010).

Currently seven states have committed to providing some form of universal preschool for 4-year-old children (Florida, Georgia, Illinois, Iowa, New York, Oklahoma, and West Virginia) (National Institute for Early Education Research [NIEER], 2009). However, out of these only Oklahoma has implemented a program that both adheres to high-quality standards and is close to serving children at a universal level. In addition to these states, additional state-funded preschool programs have been implemented on a limited scale; however, these programs have not been set up to provide access to all preschool children within the state.

Proponents of universal preschool view it as advantageous in comparison to targeted preschool programs in a number of ways. First, universal preschool has the ability to reach a larger number of at risk children, in comparison to targeted programs such as Head Start. Although the purpose of Head Start is to serve all preschoolers from households at or below the poverty line, statistics show that this program only reaches about 60% of eligible children (Congressional Record, 2003). Universal programs would not only increase the enrollment of children living in extreme poverty, but those who live on the edge of poverty as well.

Next, although socioeconomic status is a predictor of poor academic performance, children from low-income backgrounds are not the only ones at risk for school failure. The disparity between educational outcomes for children from middle-income versus high-income families is as great as that between children from low-income and middle-income families. Because more children actually fall into the middle-income bracket, they make up the largest number of students at risk for low academic achievement (Barnett, 2007, 2010). Children from middle-income families are also the most likely to repeat a grade or drop out of school (Barnett, 2010). Therefore, targeted preschool programs focusing on children in poverty miss a large number of children in need of extra educational support. Universal programs have the potential to provide services to children from all socioeconomic backgrounds, expanding the reach to a larger number of children with risk factors.

Having children from differing economic backgrounds enrolled in the same preschool program translates into both social and academic benefits. Not only does it help prevent stigmatization caused by participation in poverty-focused programs, but also supports inclusion of, and social interactions between, children from all economic backgrounds rather than segregation based on income. Research also suggests that children from low-income backgrounds may actually learn more when enrolled in preschool programs that include children from wider range of socioeconomic backgrounds (Barnett, Brown & Shore, 2004; Barnett & Freide, 2010; Gormley et al., 2010). Including children from middle- and high-income families in universal preschool can positively impact their educational growth as well. Research indicates that high quality preschool programs benefit *all* children, with children from middle- and high-income backgrounds making positive academic gains (Barnett et al., 2004; Barnett & Freide, 2010; Gormley, Gayer, Phillips, & Dawson, 2005).

It is important to emphasize that an essential component to universal preschool is providing high-quality services. Research indicates that the quality of early education programs is directly linked to program results (Barnett et al., 2004; Burchinal et al., 2008; Burchinal, Vandergrift, Pianta, & Mashburn, 2010). There have been some efforts to create universal care by subsidizing existing child-care and preschool programs, without setting mandatory standards for quality. Although this may be a less-expensive way to provide care for a larger number of children, it would not result in the same gains as those created by high-quality care. Proponents of universal preschool suggest incorporating such programs into public education as a way to help ensure program quality. Within this system, preschool programs would be held accountable to certain standards and linked to existing supports.

One example of high-quality universal preschool is Oklahoma's state-funded program. Established in 1998, this universal model has led to impressive results. Free, voluntary preschool is offered for all 4-year-olds within the state; as of 2009, 71% of 4-year-olds were enrolled in the program (NIEER, 2009). The number of 4-year-olds served by state and federal funded preschool rises even higher—to 87%, when children enrolled in Oklahoma's Head Start are included (NIEER). Oklahoma's universal preschool is delivered through the public school system with quality standards established for the program. These standards emphasize components that research findings support as related to the delivery of high-quality services. All preschool teachers are required to hold both a bachelor's degree and early childhood certificate, as well as participate in continuing professional development. The class size is limited to 20 students, with a minimum student-teacher ratio of 10 to 1. Preschool teachers receive the same salary and benefits as public school teachers in their area, making their pay significantly higher than that of typical preschool teachers (Gormley & Phillips, 2005).

Studies on the effects of the Oklahoma universal preschool program indicate that it has a significant impact on educational achievement across child characteristics, including class and race. A 2005 research study found that children who attended the program made substantial gains in vocabulary, literacy, and math skills. Significant differences in gains were found between children who attended the program and comparable children who did not attend the program, with attendees scoring 28% higher in vocabulary and 44% higher in math (Lamy, Barnett, & Jung, 2005). Another study, focused specifically on children who attended the Tulsa, Oklahoma, preschool programs, indicated that attendees had a 16% increase in overall test scores. The most significant gains were made by African-American and Hispanic children, as well as children from low-income backgrounds (Gormley & Phillips, 2005).

Oklahoma serves as an example of the potential of universal preschool. However, there remain many obstacles that stand in the way of making universal preschool a reality throughout the United States. The cost of such programs is one of the biggest barriers to its implementation. Although cost-benefit analyses predict that universal preschool would create a substantial return in lower spending for remediation efforts and other social programs, it is difficult to get such programs established during a time of economic hardship for state governments. Proponents insist that such investments in early education are well worth making, and continue to make the case for creating government funded preschool for all. Universal preschool is an issue that will continue to be debated and explored as more states look at ways to bolster their educational systems and help children succeed academically.

The Impact of Technology on Early Childhood Education

The prevalence of technological devices (e.g., computers, television, iPads) opens a new era in instructional delivery at all ages. Relevant to early childhood, there is a need to more clearly understand the role of computers and other technological advances in early childhood classrooms, and how such advances are helping to optimize learning opportunities and facilitate diverse instructional approaches. For example, playing videos or audios of instructional materials in the classroom may fulfill different learning needs. Classroom teachers can use computers, game applications, televisions, or projectors to provide various activities that relate to a weekly theme. Technological devices and related applications can facilitate general knowledge acquisition in addition to printed materials, as well as teach pre-academic skills such as letter and number recognition (Schmid, Miodrag, Di Francesco, 2008; Vernadakis, Avgerinos, Tsitskari, Zachopoulou, 2005). In preschool classrooms, children can practice letters and sounds by playing computer games. This allows children to practice several times, and provide visual and audio stimulations for different learning needs. Additionally, practicing through computerized activities may promote peer collaboration in problem solving (Grieshaber, 2010; Ljung-Djarf, 2008). Classroom teachers can teach sharing and turn taking in the process.

Many early childhood professionals consider acquiring familiarity with technology applications is essential for children during their early years. Even though the importance of including the use of computer is recognized, this trend has led to debates between professionals about the extra expense of technology and the finding that additional visual-audio stimulations for children may result in less physical activity because of time spent in front of computers and television sets. Nonetheless, recognition of the importance of exposure to technological applications not only provides children with multiple learning strategies, but also teaches children to appropriately use technology to enhance their cognitive abilities (NAEYC, 1996).

The early work of incorporating computers in the field of early childhood education first began with “Logo,” a programming language targeted on educational use. “Logo” was based on Piaget’s constructivism learning theory and aimed at promoting academic skills, problem-solving skills and social emotional development of children (Clements & Meredith, 1992). Results of a study that focused on the effects and efficacy of “Logo” indicated that computer exposure was not enough for acquiring skills. Thus the addition of teacher mediation (e.g., coaching, clarification, and explanation) provides the solid theoretical foundation and structure for utilizing computer for instruction (Clements & Meredith). In the future, when advanced portable technological devices are introduced to children, the model that is chosen for implementing technology in the classroom will be a critical component for eliciting learning effects (Couse & Chen, 2010).

Even though most early childhood education programs are equipped with audio and visual devices, a report from the National Center for Education Statistics (NCES) indicated that only half of public school teachers incorporate technology in their instruction (Judson, 2006). In their technology position statement, NAEYC emphasizes the importance of teachers making professional judgments about the use of technology in their classrooms (NAEYC, 1996). Aspects to consider include the background of children and their families, the societal expectations about children learning technology, and the advantages and disadvantages of specific instructional approaches (Siu & Lam, 2005). A lack of knowledge about technology may prohibit teachers from making appropriate decisions. It is important to mitigate this gap by providing sufficient training to teachers to support the integration of technology into their instruction. Ongoing and well-designed professional development can increase teachers’ confidence and ability in using instructional technologies to support child development (Haugland, 2000; Haugland & Wright, 1997; Keengwe & Onchwari, 2009).

Technology is constantly evolving and renewing. By providing culturally relevant and developmentally appropriate technology instruction to children, and sufficient professional development to early childhood professionals, technology will be integrated into early education in a seamless and advantageous manner for our youngest learners.

SUMMARY AND CONCLUSIONS

As we move into the future, we must respond to the challenges that emerge. Technological advances, research findings related to brain development and functioning, medical breakthroughs, and advances in evidence-based educational practices will no doubt transport our current early childhood landscape into something yet again unique.

Increased diversity in the U.S. population—with currently more than 1 in 5 children (22%) under 18 years of age of Latino ethnicity and other diverse groups rapidly growing (http://pewhispanic.org/reports/report), increasing poverty rates among families with children, and stressed economic conditions will mean that programs serving young children may need to use more focused and specialized approaches for improving children’s well-being and their developmental and cognitive outcomes. In addition to utilizing technological advances, evidence-based, theoretically driven models, and gathering ongoing evidence on educational efforts, what are other considerations that might improve outcomes for our youngest segments of the population?

First, universal screening of *all* young children at regular intervals, as supported by the American Academy of Pediatrics (2006), is advocated. A key to successful prevention of and intervention for, developmental problems is early detection. Developmental as well as social-emotional/behavioral screening will assure that children who need specialized instruction are identified and able to receive it at the earliest point in time. Screening for social-emotional delays including autism will result in vastly improved child and family outcomes.

Second, access to high-quality early childhood programs—universal preschool—is supported as a way to assure that all young children enter school "ready to learn." Head Start programs currently serve almost 1 million children across the United States; however, at least an equal number of low-income, high-risk children do not access such programs. Although universal preschool programs would cost a significant amount of money initially, they would have a substantial payoff in the future—with benefits doubling the cost of programs within 30 years (Lynch, 2010). Higher graduation rates, improved work force skills, lower crime rates, and improved social outcomes would result (Lynch, 2010). The "meaningful differences"—widening gaps in vocabulary growth, language production, and other skills—that differentiate poor and middle class children—will be minimized with universal access to high-quality preschool programs (Hart & Risley, 1995).

Third, early childhood education should be delivered in inclusive environments where "the values, policies, and practices . . . support the right of every infant and young child and his or her family, regardless of ability, to participate in a broad range of activities and contexts as full members of families, communities, and society" (NAEYC/DEC, 2009). Diverse children and families should feel a sense of belonging and membership, experience positive relationships and friendships, and develop and learn to reach their full potential in early childhood settings. Universal design—modifying environments so that access and learning is maximized for all children and their families—can serve as a foundation for inclusive environments.

Finally, although children should enter school "ready to learn," the early childhood years should be treasured as a magical time, when development unfolds at dizzying speeds, and play, imagination, cognitive abilities, and language skills explode. Early childhood education should be fun and active, play based, with motivating, activity-embedded learning strategies. Meaningful, authentic activities and satisfying relationships should drive a holistic approach in which skills and early academic learning are embedded in a child-focused and fun environment.

Ongoing research on evidence-based, effective practices is a primary requirement for continued effective early childhood efforts. Development of high-quality personnel training options is also critical—with practice-based preservice training and ongoing coaching and mentoring models. Continued public policy refinement supporting young children and families is necessary to implement and support new structures that entail collaborative, coordinated, interagency systems. Through our coordinated and focused efforts, we can improve outcomes and maximize the impact that we have on young children and families, creating a brighter future for all.

REFERENCES

American Academy of Pediatrics. (2001). Developmental surveillance and screening of infants and young children. *Pediatrics, 108*(1), 192–196.

American Academy of Pediatrics. (2006). Identifying infants and young children with developmental disorders in the medical home: An algorithm for developmental surveillance and screening. *Pediatrics, 118*(1), 405–420.

Bagnato, S., Neisworth, J., & Pretti-Frontczak, K. (2010). Linking authentic assessment and early childhood intervention: Best measures for best practice (2nd ed.). *LINKing authentic assessment and early childhood intervention: best measures for best practice* (2nd ed.). Baltimore, MD: Brookes.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development, 6. Six theories of child development* (pp. 1–60). Greenwich, CT: JAI Press.

Barnes, H. (1991). Learning that grows with the learner: An introduction to Waldorf education. *Educational Leadership, 49*(2), 52–54.

Barnett, D. W., VanDerHeyden, A. M., & Witt, J. C. (2007). Achieving science-based practice through response to intervention: What it might look like in preschools. *Journal of Educational and Psychological Consultation, 17*(1), 31–54.

Barnett, W. S. (2003). Better teachers, better preschools: Student achievement linked to teacher qualifications. *Preschool Policy Matters,* 2. Retrieved from http://nieer.org/resources/policybriefs/2.pdf

Barnett, W. S. (2007). Benefits and costs of quality early childhood education. *Children's Legal Rights Journal (CLRJ), 27*(1), 7–23.

Barnett, W. S. (2008). *Preschool education and its lasting effects: Research and policy implications.* Boulder and Tempe: Education and the Public Interest Center & Education Policy Research Unit. Retrieved from http://epicpolicy.org/publication/preschooleducation

Barnett, W. S. (2010). Universal and targeted approaches to preschool education in the United States. *International Journal of Child Care and Education Policy, 4*(1), 1–12.

Barnett, W. S., & Belfield, C. (2006). Early childhood development and social mobility. *Future of Children, 16*(2), 73–98.

Barnett, W. S., Brown, K., & Shore, R. (2004). The universal vs. targeted debate: Should the United States have preschool for all? *Preschool Policy Matters, 6*. Retrieved from http://nieer.org/resources/policybriefs/6.pdf

Barnett, W. S., & Freide, E. (2010). The promise of preschool: Why we need early education for all. *American Educator, 34*(1), 21–29.

Barnett, W. S., & Masse, L. (2007). Comparative benefit-cost analysis of the abecedarian program and its policy implications. *Economics of Education Review, 26*(1), 113–125.

Bayat, M., Mindes, G., & Covitt, S. (2010). What does RTI (response to intervention) look like in preschool? *Journal of Early Childhood Education, 37*, 493–500. doi: 10.1007/s10643-010-0372-6

Behen, M., Helder, E., Rothermel, R., Solomon, K., & Chugani, H. (2008). Incidence of specific absolute neurocognitive impairment in globally intact children with histories of early severe deprivation. *Child Neuropsychology, 14*(5), 453–469.

Berk, L., Christensen, C. G., & Harris, S. (2010). *Infants and children: prenatal through middle childhood*. Boston, MA: Pearson.

Beverly, B., McGuinness, T., & Blanton, D. (2008). Communication and academic challenges in early adolescence for children who have been adopted from the former Soviet Union. *Language, Speech, and Hearing Services in Schools, 39*(3), 303–313.

Blasco, P. M. (2001). *Early intervention services for infants, toddlers, and their families*. Needham Heights, MA: Allyn & Bacon.

Bradley, R., Danielson, L., & Doolittle, J. (2007). Responsiveness to intervention: 1997 to 2007. *Teaching Exceptional Children, 39*(5), 8–12.

Bricker, D. (1989). *Early intervention for at-risk and handicapped infants, toddlers, and preschool children* (2nd ed.). Palo Alto, CA: VORT.

Bricker, D. (2002). *Assessment, evaluation, and programming system for infants and children: volumes 1-4 administration guides* (2nd ed.) Baltimore, MD: Brookes.

Bricker, D., Clifford, J., Yovanoff, P., Pretti-Frontczak, K., Waddell, M., Allen, D., & Hoselton, R. (2008). Eligibility determination using a curriculum-based assessment, a further examination. *Journal of Early Intervention, 31*(1), 3–21.

Briggs, M. H. (1997). *Building early intervention teams: Working together for children and families*. Gaithersburg, MD: Aspen.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Bruckman, M., & Blanton, P. W. (2003). Welfare-to-work single mothers' perspectives on parent involvement in head start: Implications for parent-teacher collaboration. *Early Childhood Education Journal, 30*, 145–150.

Bruder, M. B. (2010). Early childhood intervention: A promise to children and families for their future. *Exceptional Children, 76*, 339–355.

Burchinal, M., Howes, C., Pianta, R., Bryant, D., Early, D., Clifford, R., & Barbarin, O. (2008). Predicting child outcomes at the end of kindergarten from the quality of pre-kindergarten teacher-child interactions and instruction. *Applied Developmental Science, 12*(3), 140–153.

Burchinal, M., Vandergrift, N., Pianta, R., & Mashburn, A. (2010). Threshold analysis of association between child care quality and child outcomes for low-income children in pre-kindergarten programs. *Early Childhood Research Quarterly, 25*(2), 166–176.

Cadwell, L. B. (1997). *Bringing Reggio Emilia home: An innovative approach to early childhood education*. New York, NY: Teachers College Press.

Clements, D. H., & Meredith, J. S. (1992). Research on logo: Effects and efficacy. Retrieved from Logo Foundation: http://el.media.mit.edu/logo-foundation/pubs/papers/research_logo.html

Coleman, M. R., Buysse, V., & Neitzel, J. (2006). *Recognition and response: An early intervening system for young children at-risk for learning disabilities*. Chapel Hill: University of North Carolina at Chapel Hill, EPG Child Development Institute.

Committee on Pediatric Workforce. (2011). Reaffirmed policy statement–Pediatric primary health care. *Pediatrics, 127*(2).

Conderman, G., & Johnston-Rodriguez, S. (2009). Beginning teachers' views of their collaborative roles. *Preventing School Failure, 53*, 235–244.

Congressional Record, Vol. 1963-1966, at 14433. (2003).

Conyers, L., Reynolds, A., & Ou, S. (2003). The effect of early childhood intervention and subsequent special education services: Findings from the Chicago child-parent centers. *Educational Evaluation & Policy Analysis, 25*(1), 75–95.

Copple, C., & Bredekamp, S. (2006). *Basics of developmentally appropriate practice: An introduction for teachers of children 3 to 6*. Washington, DC: National Association for the Education of Young Children.

Copple, C., & Bredekamp, S. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC: National Association for the Education of Young Children.

Couse, L. J., & Chen, D. W. (2010). A tablet computer for young children? Exploring its vaiability for early childhood education. *Journal of Research on Technology in Education, 43*, 75–98.

DEC/NAEYC. (2009). *Early childhood inclusion: A joint position statement of the division for early childhood (DEC) and the national association for the education of young children (NAEYC)*. Chapel Hill: University of North Carolina, FPG Child Development Institute.

Dinnebeil, L., Hale, L., & Hale, L. (1996). A qualitative analysis of parents' and service coordinators' descriptions of variables that influence collaborative relationships. *Topics in Early Childhood Special Education, 16*, 322–347.

Dodge, D. T., Colker, L. J., & Barrett, J. (1992). *The creative curriculum for early childhood*. Washington, DC: Teaching Strategies.

Early Head Start National Resource Center. (2010). What is early Head Start? www.ehsnrc.org/AboutUs/ehs.htm

Espinosa, L. (2002). High-quality preschool: Why we need it and what it looks like. *Preschool Policy Matters,1*. Retrieved from http://nieer.org/resources/policybriefs/1.pdf

Fixsen, D. L., Naoom, S. F., Blase, K. A., Friedman, R. M., & Wallace, F. (2005). *Implementation research: A synthesis of the literature*. Tampa, FL: National Implementation Research Network.

Fox, L., Carta, J., Strain, P. S., Dunlap, G., & Hemmeter, M. L. (2010). Response to intervention and the pyramid model. *Journal of Infants and Young Children, 23*(1), 3–13

Frodl, T., Reinhold, E., Koutsouleris, N., Reiser, M., & Meisenzahl, E. (2010). Interaction of childhood stress with hippocampus and prefrontal cortex volume reduction in major depression. *Journal of Psychiatric Research, 44*(13), 799–807.

Fuchs, L. S. (2003). Assessing intervention responsiveness: Conceptual and technical issues. *Learning Disabilities Research & Practice, 18*(3), 172–186.

Fuchs, D., Fuchs, L., & Stecker, P. M. (2010). The "blurring" of special education in a new continuum of general education placements and services. *Exceptional Children, 76*, 301–323.

Fuchs, D., Mock, D., Morgan, P. L., & Young, C. L. (2003). Responsiveness-to-intervention: Definitions, evidence, and implications for the learning disabilities construct. *Learning Disabilities Research & Practice, 18*(3), 157–171.

Gagnon, C., Craig, W., & Tremblay, R. (1995). Kindergarten predictors of boys' stable behavior problems at the end of elementary school. *Journal of Abnormal Child Psychology, 23*, 751–766.

Ginsburg, H., & Opper, S. (1969). *Piaget's theory of intellectual development: An introduction*. Englewood Cliffs, NJ: Prentice-Hall.

Gormley, W., Gayer, T., Phillips, D., & Dawson, B. (2005). The effects of universal pre-k on cognitive development. *Developmental Psychology, 41*(6), 872–884.

Gormley, W., & Phillips, D. (2005). The effects of universal pre-k in Oklahoma: Research highlights and policy implications. *Policy Studies Journal, 33*(1), 65–82.

Gormley, W., Phillips, D., Adelstein, S., & Shaw, C. (2010). Head start's comparative advantage: Myth or reality? *Policy Studies Journal, 38*(3), 397–418.

Grieshaber, S. (2010). Beyond discovery: A case study of teacher interaction, young children and computer tasks. *Cambridge Journal of Education, 40*, 69–85.

Guralnick, M. J., Connor, R. T., Hammond, M. A., Gottman, J. M., & Kinnish, K. (1996). Immediate effects of mainstreamed settings on the social interactions and social integration of preschool children. *American Journal on Mental Retardation, 100*, 359–377.

Haapasalo, J., Tremblay, R., Boulerice, B., & Vitaro, F. (2000). Relative advantages of person- and variable-based approaches for predicting problem behaviors from kindergarten assessments. *Journal of Quantitative Criminology, 16*(2), 145–168.

Hainstock, E. G. (1986). *The essential Montessori*. New York, NY: New American Library.

Harris, K., & Klein, M. (2002). Itinerant consultation in early childhood special education: Issues and challenges. *Journal of Educational & Psychological Consultation, 13*(3), 237–247.

Harris, K., & Klein, M. (2004). Mini-theme: "An emergent discussion of itinerant consultation in early childhood special education." *Journal of Educational & Psychological Consultation, 15*(2), 123–126.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Brookes.

Harvey, M. W., Yssel, N., Bauserman, A. D., & Merbler, J. B. (2010). Preservice teacher preparation for inclusion: An exploration of higher education teacher-training institutions. *Remedial and Special Education, 31*(1), 24–33. doi: 10.1177/0741932508324397

Haugland, S. W. (2000). What role should technology play in young children's learning? Part 2. *Young Children, 55*, 12–18.

Haugland, S. W., & Wright, J. L. (1997). *Young children and technology: A world of discovery*. Boston, MA: Allyn & Bacon.

Hemmeter, M. L., Joseph, G., Smith, B. J., & Sandall, S. (Eds.). (2001). *DEC recommended practices program assessment: Improving practices for young children with special needs and their families*. Missoula, MT: Division for Early Childhood.

HighScope Educational Research Foundation. (1992). *High/Scope child observation record: For ages 2-6*. Ypsilanti, MI: High/Scope Press.

Hojnoski, R. L., & Missal, K. N. (2010). Social development in preschool classrooms: Promoting engagement, competence, and school readiness. In M. R. Shinn & H. M. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI*. Bethesda, MD: National Association of School Psychologists.

Isaacs, B. (2007). *Bringing the Montessori approach to your early years practice*. London, UK: Routledge.

Jackson, S., Pretti-Frontczak, K., Harjusola-Webb, S., Grishman-Brown, J., & Romani, J. M. (2009). Response to intervention: Implications for early childhood professionals. *Language, Speech and Hearing Services in Schools, 40*, 424–434.

Johnson-Martin, N., Hacker, B. J., & Attermeier, S. M. (2004a). *The Carolina curriculum for infants and toddlers with special needs*. Baltimore, MD: Brookes.

Johnson-Martin, N., Hacker, B. J., & Attermeier, S. M. (2004b). *The Carolina curriculum for preschoolers with special needs*. Baltimore, MD: Brookes.

Judge, S. (2003). Developmental recovery and deficit in children adopted from eastern European orphanages. *Child Psychiatry and Human Development, 34*(1), 49–62.

Judson, E. (2006). How teachers integrate technology and their beliefs about learning: Is there a connection? *Journal of Technology and Teacher Education, 14*(3), 581–597.

Justice, L. (2006). Evidence-based practice, response to intervention, and the prevention of reading difficulties. *Language, Speech and Hearing Services in School, 37*, 284–297.

Keengwe, J., & Onchwari, G. (2009). Technology and early childhood education: A technology integration professional development model for practicing teachers. *Early Childhood Education Journal, 37*(3), 209–218.

Kinney, L., & Wharton, P. (2008). *An encounter with Reggio Emilia: Children's early learning made visible*. London, UK: Routledge.

Korfmacher, J., Green, B., Staerkel, F., Peterson, C., Cook, G., Roggman, L., . . . Schiffman, R. (2008). Parent involvement in early childhood home visiting. *Child & Youth Care Forum, 37*(4), 171–196.

Lamy, C., Barnett, W. S., & Jung, K. (2005). *The effects of Oklahoma's early childhood four-year-old program on young children's school readiness*. New Brunswick, NJ: National Institute for Early Education Research, Rutgers University.

Leppanen, U., Aunola, K., Niemi, P., & Nurmi, J. (2008). Letter knowledge predicts grade 4 reading fluency and reading comprehension. *Learning and Instruction, 18*(6), 548–564.

Ljung-Djarf, A. (2008). The owner, the participant and the spectator: Positions and positioning in peer activity around the computer in pre-school. *Early Years: Journal of International Research and Development, 28*, 61–72.

Locuniak, M., & Jordan, N. (2008). Using kindergarten number sense to predict calculation fluency in second grade. *Journal of Learning Disabilities, 41*(5), 451–459.

Lynch, R. (2010). The cost effectiveness of public investment in high-quality prekindergarten: A state-level synthesis. In Reynolds, A., Rolnick, A., Englund, M., & Temple, J. (Eds.), *Childhood programs and practices in the first decade of life* (35–341). Cambridge, UK: Cambridge University Press.

Moffitt, T., Arseneault, L., Belsky, D., Dickson, N., Hancox, R., Harrington, H., . . . Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences, USA, 108*(7), 2693–2698.

Mooney, C. G. (2000). *Theories of childhood: An introduction to Dewey, Montessori, Erikson, Piaget & Vygotsky*. St. Paul, MN: Redleaf Press.

National Association for the Education of Young Children. (1996, April). Technology and young children–Ages 3 through 8. www.naeyc.org/files/naeyc/file/positions/PSTECH98.PDF

National Institute for Early Education Research. (2009). *Oklahoma state preschool yearbook*. http://nieer.org/yearbook/states/

National Scientific Council on the Developing Child. (2004). *Children's emotional development is built into the architecture of their brains*. Working paper No. 2. www.developingchild.harvard.edu

National Scientific Council on the Developing Child. (2005). *Excessive stress disrupts the architecture of the developing brain*. Working paper No. 3. www.developingchild.harvard.edu

National Scientific Council on the Developing Child. (2007). *The timing and quality of early experiences combine to shape brain architecture.* Working paper No. 5. www.developingchild.harvard.edu

Nores, M., Belfield, C., & Barnett, W. (2005). Updating the economic impacts of the High/Scope Perry preschool program. *Educational Evaluation & Policy Analysis, 27*(3), 245–261.

Nutbrown, C., Clough, P., & Selbie, P. (2008). *Early childhood education: History, philosophy and experience*. Los Angeles, CA: Sage.

O'Connor, T., Rutter, M., Beckett, C., Keavency, L., & Kreppner, J. (2000). The effects of global severe privation on cognitive competence: Extension and longitudinal follow-up. *Child Development, 71*(2), 376–390.

Odom, S. L. (1998). *Social relationships of preschool children with disabilities in inclusive settings*. Paper presented at the Research to Practice Summit, Washington, DC. www.nectac.org/inclusion/meetings/rs_social.asp

Odom, S. L. (2000). Preschool inclusion: What we know and where we go from here. *Topics in Early Childhood Special Education, 20*, 20–27.

Office of Head Start, U.S. Department of Health and Human Services. (2010). *Program services*. www.acf.hhs.gov/programs/ohs/programs/index.html

Peisner-Feinberg, E., Burchinal, M., Clifford, R., Culkin, M., Howes, C., Kagan, S. L., & Yazejian, N. (2001). The relation of preschool child-care quality to children's cognitive and social developmental trajectories through second grade. *Child Development, 72*(5), 1534–1553.

Petrash, J. (2002). *Understanding Waldorf education: Teaching from the inside out*. Silver Spring, MD: Gryphon House.

Pretti-Frontczak, K., & Bricker, D. D. (2004). *An activity-based approach to early intervention*. Baltimore, MD: Brookes.

Ramey, C., & Ramey, S. (2004). Early learning and school readiness: Can early intervention make a difference? *Merrill-Palmer Quarterly, 50*(4), 471–491.

Rao, H., Betancourt, L., Giannetta, J., Brodsky, N., Korczykowski, M., Avants. B., . . . Farah, M. (2010). Early parental care is important for hippocampal maturation: Evidence from brain morphology in humans. *NeuroImage, 49*(1), 1144–1150.

Raver, S. A. (2009). *Early childhood special education, 0 to 8 years: Strategies for positive outcomes*. Upper Saddle River, NJ: Merill/Pearson.

Reynolds, A., Ou, S., & Topitzes, J. (2004). Paths of effects of early childhood intervention on educational attainment and delinquency: A confirmatory analysis of the Chicago child- parent centers. *Child Development, 75*(5), 1299–1328.

Reynolds, A., Temple, J., White, B., Ou, S., & Robertson, D. (2011). Age 26 cost-benefit analysis of the child-parent center early education program. *Child Development, 82*(1), 379–404.

Rose, E. R. (2010). *The promise of preschool: From Head Start to universal pre-kindergarten*. Oxford, UK: Oxford University Press.

Rowan-Kenyon, H. (2007). Predictors of delayed college enrollment and the impact of socioeconomic status. *Journal of Higher Education, 78*(2), 188–214.

Sandall, S., Hemmeter, M. L., Smith, B. J., & McLean, M. E. (2005). *DEC recommended practices: A comprehensive guide for practical approach*. Missoula, MT: Division for Early Childhood.

Schmid, R., Miodrag, N., & Di Francesco, N. (2008). A human-computer partnership: The tutor/child/computer triangle promoting the acquisition of early literacy skills. *Journal of Research on Technology in Education, 41*, 63–84.

Schore, A. (2001). The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal, 22*(1-2), 1–2.

Schweinhart, L. J. (2005). *Lifetime effects: The High/Scope Perry preschool study through age 40*. Ypsilanti, MI: High/Scope Press.

Shonkoff, J. P., & Phillips, D. (2000). *From neurons to neighborhoods: The science of early child development*. Washington, DC: National Academy Press.

Siu, K., & Lam, M. (2005). Early childhood technology education: A sociocultural perspective. *Early Childhood Education Journal, 32*(6), 353–358.

Snyder, P. A., Wixson, C. S., Talapatra, D., & Roach, A. T. (2008). Assessment in early childhood instruction-focused strategies to support response-to-intervention frameworks. *Assessment for Effective Intervention, 34*(1), 25–34.

Soodak, L. C., & Erwin, E. J. (1995). Parents, professionals and inclusive education: A call for collaboration. *Journal of Education and Psychological Consultation, 6*, 257–276.

South, S., Baumer, E., & Lutz, A. (2003). Interpreting community effects on youth educational attainment. *Youth & Society, 35*(1), 3–36.

Squires, J. (2010). Designing and implementing effective preschool programs: A linked systems approach for social emotional early learning. In M. Shinn & H. Walker (Eds.), *A three tier approach to prevention of behavior problems* (pp. 293–312). Bethesda, MD: National Association of School Psychologists.

Squires, J., & Bricker, D. (2007). *An activity-based approach to developing young children's social emotional competence*. Baltimore, MD: Brookes.

Squires, J., Twombly, E., Bricker, D., & Potter, L. (2009). *ASQ-3: User's guide*. Baltimore, MD: Brookes.

Squires, J., Nickel, R., & Eisert, D. (1996). Early detection of developmental problems: Strategies for monitoring young children in the practice setting. *Journal of Developmental and Behavioral Pediatrics, 17*(6), 420–427.

Tajalli, H., & Opheim, C. (2005). Strategies for closing the gap: Predicting student performance in economically disadvantaged schools. *Educational Research Quarterly, 28*(4), 44–54.

Temple, J., & Reynolds, A. (2007). Benefits and costs of investments in preschool education: Evidence from the child-parent centers and related programs. *Economics of Education Review, 26*(1), 126–144.

Thompson, R. A. (2009). Connecting neurons, concepts, and people: Brain development and implications. In NIEER publications, *Preschool policy facts*. http://nieer.org/resources/factsheets/21.pdf

Tottenham, N., Hare, T., Quinn, B., McCarry, T., Nurse, M., Gilhooly, T., . . . Casey, B. J. (2010). Prolonged institutional rearing is associated with atypically large amygdala volume and difficulties in emotion regulation. *Developmental Science, 13*(1), 46–61.

U.S. Department of Education, Office of Special Education Programs, Data Analysis System. (2009). *Children with disabilities receiving special education under part B of the individuals with disabilities education act* (DANS OMB #1820-0043). https://www.ideadata.org/arc_toc9.asp#partbEX

U.S. Department of Health and Human Services, Administration for Children and Families. (2010a). Head Start Impact Study. Final Report. Washington, DC.

U.S. Department of Health & Human Services. (2010b). Head Start program fact sheet fiscal year 2010. http://eclkc.ohs.acf.hhs.gov/hslc/Head%20Start%20Program/Head%20Start%20Program%20Factsheets/fHeadStartProgr.htm

VanDerHeyden, A. M., & Snyder, P. (2006). Integrating frameworks from early childhood intervention and school psychology to accelerate growth for all young children. *School Psychology Review, 35*, 519–534.

van IJzendoorn, M., Luijk, M., & Juffer, F. (2008). IQ of children growing up in children's homes. *Merrill-Palmer Quarterly, 54*(3), 341–366.

Vernadakis, N., Avgerinos, A., Tsitskari, E., & Zachopoulou, E. (2005). The use of computer assisted instruction in preschool education: Making teaching meaningful. *Early Childhood Education Journal, 33*, 99–104.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Walker, D., Carta, J. J., Greenwood, C. R., & Buzhardt, J. F. (2008). The use of individual growth and developmental indicators for progress monitoring and intervention decisions making in early education. *Exceptionality, 16*, 33–47.

Walker, H., Severson, H. H., & Seeley, J. (2010). Universal, school-based screening for the early detection of academic and behavioral problems contributing to later destructive outcomes. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including response to intervention* (pp. 677–702). Silver Spring, MD: National Association of School Psychologists.

Weber, E. (1984). *Ideas influencing early childhood education: A theoretical analysis*. New York, NY: Teachers College Press.

Wight, V. R., Chau, M., & Aratani (2011). Who are America's poor children?: The *official story*. www.nccp.org/publications/pdf/text_1001.pdf

CHAPTER 12

The Psychology and Pedagogy of Reading Processes

P. DAVID PEARSON AND GINA CERVETTI

As we approach the monumental task of living up to the standard imposed by our predecessor, the late Michael Pressley, in writing the reading chapter for this, the seventh volume in the series of *Handbooks of Psychology*, we are both privileged and humbled by the opportunity of continuing the legacy of providing a comprehensive account of new theoretical and empirical contributions to reading research. Respectful of the cross-age approach that Pressley took in the last volume (account for progress of beginning readers, adolescent and adult readers—and along the way highlight some pedagogical processes that are salient at all levels, such as word recognition, vocabulary, and comprehension), we took a different approach.

We decided to focus on reading as a fundamentally cognitive process that can be influenced by contextual forces at many levels, most notably for education, schools, and policy environments. Thus we deal with the fundamental psychological aspects of reading—*word-level processes* (including subword processes such as phonological awareness and decoding, word reading, and vocabulary, with all of its entailments), and *text-level processes* as they are grounded in structures, genres, and disciplinary knowledge pursuits. After the account of these cognitive processes, we turn to a *setting-level analysis*, in which we examine word- and text-level processes within schooling (including instruction in English language arts and the subject matters of history and science) and policy contexts.

As we unpack each element in our review, our goal is to answer the question: How has what we have learned in the last decade advanced the knowledge base available to us? As we move to setting level analysis, we meet head on practices that have emerged less to understand and more to improve the acquisition of those processes among students in our schools (though not always with positive effects!). We end intentionally with what might be considered an anomaly in the *Handbook of Educational Psychology*—a section on the policy context in which debates about the science of reading, especially reading pedagogy, occur. Reading has, for better or worse, always been contested ground. And even the very act of reading—whether for gist, enjoyment, or critique—is never free of ideology.

Our method for locating research relevant to our charge was to rely first on highly regarded syntheses and analyses of the research base, most notably in our case (a) the 2006 handbook, *The Science of Reading* (Snowling & Hulme, 2005), (b) Volume IV of the *Handbook of Reading Research* (Kamil, Pearson, Moje, & Afflerbach, 2011), and (c) seminal reviews, including meta-analyses, appearing in national initiatives (e.g., *Preventing Reading Difficulties* and the *National Reading Panel*) and in other outlets. From there we worked our way back to individual research articles that were important in their own right and/or typical of a large class of studies. And, in areas in which we work, we relied on our professional knowledge of the most important reviews and research studies.

A review such as this, in which we try to capture in a handful of pages what has taken others a full tome to unpack, is necessarily selective. We could not hope to convey either the breadth or depth of scholarship of the field, not even the past decade. So we apologize in advance to all of our colleagues whose work we did not cite and all users whose favorite topics are omitted. All we can hope for is that we have chosen, in our selection process, important and relevant (if not *the* most important and *the* most relevant) topics to guide readers who want to know what matters most in the psychological foundations of basic processes and instructional practices in reading.

One final introductory comment: We come close, in the chapter title, to plagiarizing another of our heroes, Edmund Burke Huey, in the title of his landmark 1908 book, *The Psychology and Pedagogy of Reading*. The similarity is intentional. Huey was a remarkable scholar who reflected both the issues and understandings of the day and anticipated phenomena and insights that would not appear in the research until five decades after his career had ended. That we could achieve either of those goals for these times—reflecting the present and anticipating the future—would please us enormously. But even if we cannot achieve either of those goals, at least we have our "titled" brush with history.

EXAMINING BASIC READING PROCESSES

For our purposes, basic processes include those processes that enable to us perceive, pronounce, and understand words and those that enable us to build models of meaning for—and use information and insights from—sentences, paragraphs, and entire passages of text.

Word-Level Processes

Word-level processes are defined as those entailed in word recognition, either as component or prerequisite skills. Specifically, we discuss word recognition and its acquisition, phonological awareness, and vocabulary.

Expert Word Recognition

Over the past 40 years, we have learned a great deal about the complex nature of word recognition among skilled readers, in particular about the manner in which recognition is conditioned by a range of lexical and semantic structures—some promoting bottom-up and others top-down processing—that interact with one another in the word recognition process (see Lupker, 2005). These advances notwithstanding, a central (perhaps *the* central) debate in word recognition is whether the pathway from the orthographic representation in print to lexical representation in memory is mediated by a phonological representation prior to recognition. The data (see Van Orden & Kloos, 2005, for a systematic review) are, at best, ambiguous. Some evidence points to phonological mediation; for example, the categorization of a homophone like *brake* as part of a car, an obvious clue for *break*, occurs with some frequency. Other evidence points to a direct access from print to lexical representation; for example, semantic categorization errors occur often for low frequency homophones, like *peek*, but rarely for high frequency homophones like *break*, implying that with greater exposure, access for even ambiguous words is direct and automatic. These sorts of ambiguous findings have led many scholars to posit various versions of a dual route model (Coltheart, 2005; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Davis, 2010). Dual route models posit that readers go directly from print to lexical representation when words are highly familiar and unambiguous, but interpose a phonological representation on the way from print to lexical representation when words are unfamiliar and opaque. The movement in modern theories of expert word recognition is toward highly contextualized models of word recognition, models in which feedback between graphemic, phonemic, and lexical levels of analysis, implying dual if not more routes to meaning, are the order of the day (Van Orden & Kloos).

Acquiring Word Reading Skills

There are numerous accounts of the ways in which students develop as word readers, most of them organized into "stages" or "phases" in which certain approaches to reading words are statistically dominant over others (see Ehri, 2005b, for a thorough comparison of the various stage theories). We will avoid entering into the debate on the precise boundaries between stages, opting instead for "general" dispositions toward word reading that seem to hold across stages.

In order to read the words that appear before them in text, readers have several choices (Ehri, 2005a). They can read a word by *decoding*—converting the constituent letters into sounds, blending the sounds together, and pronouncing the word. They can read a word by *memory*—calling up a trace of its form and pronunciation from memory, otherwise known as sight word reading. They can read a word by *analogy*—inferring its pronunciation because of its similarity to a known word (e.g., brother is like mother except at the beginning). Finally, they can *predict* its pronunciation by relying on contextual features such as clues in the text (this must be "bark" because the text mentions a dog) or pictures, at least in the earliest stories.

Students go through a predictable set of phases in their word reading repertoire—from pre-alphabetic reading (recognizing monkey by the tail) to partially alphabetic (using salient clues such as initial letters or word families) to full alphabetic (sequentially decoding letters into sounds) to consolidated alphabetic (dynamically orchestrating all four word-reading strategies). The progression is from single to multiple approaches, where students are increasingly empowered to use all four of these word-reading processes. Furthermore, they use the processes in synergistic and complementary ways. For example, once they reach the full alphabetic stage, they can decode words readily. Once decoded, they can transfer the visual and auditory traces of a word to memory so that, after a few successful exposures, the word enters their sight word repertoire. Note that this repertoire is not limited to irregularly spelled words that must be recognized as units, but it consists of all of the words, including decodable words, that are immediately apprehended as units, without the need for arduous analysis. This "self-teaching" mechanism (see Share, 1995) is crucial in early reading development because the more words that readers can move into their sight word repertoire, the more cognitive energy they can allocate to the really challenging tasks of reading, such as inferring the meanings of obscure words, text comprehension. A similar phenomenon happens with reading by analogy, usually in the latter part of Grade 1 to early Grade 2. At this fairly advanced point in the development of their phonological recoding repertoire, readers are chunking letters into groups, such as prefixes (inter-, pre-, post-), suffixes (-est, -tion), and word families (-at, -eet, - ough). Once they have those chunks under control, they can recognize the chunks as units and transform even longer and more complex words into immediately recognizable sight words. Again, evidence of the self-teaching mechanism at work.

Phonological Awareness

A consistent finding in early reading development research, both correlational and experimental, of the past 25 years is that attention to the patterns of sounds that operate at the subword level matter (Adams, 1990; National Early Literacy Panel, 2008; National Institute of Child Health and Human Development, 2000; Snow, Burns, & Griffin, 1998). Whether we define it as awareness of the words that make up a compound (sword + fish = swordfish), the syllables within a word (tay + buhl = table), the onset-rime structure of monosyllables (buh + ad = bad), or the phonemic components of a word (buh + ah + duh = bad), phonological awareness both predicts and improves later reading achievement.

Various measures of phonological awareness are strong predictors of later reading achievement, at least through Grade 1 and into Grade 2. With respect to early indicators of later success, the NELP (2008), in an extensive meta-analysis, identified 11 variables that have proven to be moderate to strong predictors of later literacy proficiency. Six of these variables, the panel concluded, served as the "best" (i.e., strongest and most consistent) predictors. Of these six, two—alphabet knowledge (which the panel defined to include letter-sound as well as letter-name correspondences) and phonological awareness—proved to be the best of the best. This combination appears to be quite durable, having been reported as part of federal initiatives for more than 40 years, beginning with the First-Grade Studies (Bond & Dykstra, 1967), and even earlier in the work of Durrell and Murphy (1953) and extending into the 1990s and early 2000s (Adams, 1990; NICHD, 2000; Snow et al., 1998). Interestingly, an equally important finding in the predictive research is that subword factors like alphabet knowledge and phonemic awareness predict achievement for the early stages of learning to read (Grade 1 into 2), but it is early measures of language and vocabulary that predict achievement beyond the early stages (Snow et al., 1998). A more important, and equally consistent, finding about subword level factors is that, when they are taught systematically in the early stages of learning to read, they lead to an advantage over other sorts of instruction in overall reading achievement, particularly on word reading tasks (Adams, 1990; Ehri et al., 2001); NELP, 2008; NICHD, 2000; Snow et al., 1998)—but that is a matter for a later section of this review.

Several meta-analyses looking both at the impact of phonological awareness (PA) and its relationship to other early reading indicators have been published in the past decade, and they lead to somewhat different conclusions than those conducted in the previous decade. For example, Swanson, Trainin, Necoechea, and Hammill (2003) examined the relationships among PA, rapid naming (of colors, pictures, letters, numbers, or words), and word reading. Looking across 35 studies, they found that phonemic awareness was no better at predicting later word reading than other variables, such as pseudoword reading, IQ, vocabulary, orthography, spelling, or memory. One result of these later syntheses has been to cast doubt on the preeminence of phonological awareness as a predictor of reading. These studies position phonological processing as only one contributor to word reading skill, and several recent analysis have pointed, in particular, to the contribution of orthographic processing (Badian, 2001; Blaiklock, 2004; Hagiliassis, Pratt, & Johnston, 2006). Cunningham, Nathan, and Raher (2011) point out that, while phonological processing accounts for significant variance in word recognition ability, there is variance left unaccounted for, which may be attributable to orthographic processing. That additional explained variance may help account for why some children who have adequate phonological awareness fall behind in their word recognition skills. We are left with the conclusion that has characterized most reviews of phonological processing and reading—that it is a necessary but not a sufficient condition for reading success.

Vocabulary

We had difficulty deciding whether we should consider vocabulary acquisition as a "high-level" word-level process or a "low-level" text-level process. Vocabulary is, at least at a surface level, all about words and their meanings, but words, from the perspective of meaning, are only incidentally about words; they are better thought of as fundamentally conceptual entities. Thus we could just as easily locate this review as the first part of the text-level processes section.

This progress we report notwithstanding, we still have not unambiguously settled the question of why vocabulary and comprehension are so closely related, a question unpacked by Anderson and Freebody in 1981. Does learning new word meanings cause comprehension (what Anderson and Freebody label the *instrumentalist hypothesis*)? Or is vocabulary knowledge an alias for some other factor that is the real cause of comprehension—either a store of important conceptual information about the world and the various disciplines (the knowledge hypothesis) or general verbal ability (the aptitude hypothesis).

One thing is certain: The decades preceding the new millennium brought considerable research that both underscored the significance of vocabulary knowledge for success in reading—and in school more generally—and that established fundamental understandings about how vocabulary words are learned. It is well-established, for example, that vocabulary knowledge is multidimensional and incrementally acquired through repeated exposure. That is, to know a word is to know more than its definition, and knowledge of a word's definition alone is not sufficient to enhance reading comprehension (Stahl & Fairbanks, 1986). When children are exposed to words in different contexts through repeated encounters, each encounter provides new information about the word, such as contexts-of-use and aspects of the word's meaning (S. Stahl & Stahl, 2004). Exposures over time and in varied contexts, then, allow for refinement and differentiation in word knowledge. In addition, repeated encounters seem to ensure that words are known well enough to be accessed quickly during reading. McKeown, Beck, Omanson, and Pople (1985) famously found that 12 encounters with a word reliably improved understanding, but 4 encounters did not.

It is also well understood that active interaction with words enhances vocabulary acquisition. Nagy (1988) synthesized research suggesting that meaningful processing of words is an important factor in learning new words, a finding that was later affirmed by the National Reading Panel (National Institute of Child Health & Human Development, 2000). Not surprisingly, then, studies have documented that, while many words are acquired incidentally through extensive and wide reading (e.g., Nagy, Anderson, & Herman, 1987; Nagy, Herman, & Anderson, 1985), instruction of word meanings produces stronger word learning than encounters with words through reading alone (e.g., Beck, Perfetti, & McKeown, 1982; Paribakht & Wesche, 1997; Stahl & Fairbanks, 1986).

By the turn of the century, research had also established the significance of vocabulary knowledge for comprehension (Beck & McKeown, 1990; Cunningham & Stanovich, 1997) and had documented significant discrepancies in vocabulary knowledge between high- and low-socioeconomic status (SES) students (Hart & Risley, 1995).

In spite of all that we now know about vocabulary acquisition, the vexing issue of the volume of words to be taught continues to be the biggest dilemma in the instruction of vocabulary. Nearly three decades ago, Nagy and Anderson (1984) estimated that, excluding proper names, there were more than 88,500 word families represented in printed school English—far too many to teach through direct instruction. They suggested that other methods should be used to enable and encourage students to learn new words on their own. In essence, they were advocating a "self-teaching" mechanism for vocabulary.

The problem of volume is exacerbated by concerns about the discrepancy between vocabulary knowledge of low- and high-SES students, and the significance of vocabulary knowledge for literacy development. Interventions have been effective at advancing students' vocabulary knowledge, but they have so far failed to close the gap. Higher SES students tend to start school with larger vocabularies, and interventions tend to benefit students who start with more word knowledge. Marulis and Neuman (2010) conducted a meta-analysis of vocabulary intervention studies for pre-K and kindergarten children. While the overall impact of vocabulary instruction was strong, middle- and upper-income children benefited most from the instruction.

In recent years, several lines of work have arisen in part to address the problem of volume. Foremost among these has been the attempt to identify a core vocabulary as a way of focusing attention on a smaller number of important words. There have been a number of recent attempts to identify a corpus of "academic vocabulary" words—words worth teaching because they appear frequently in school texts (Baumann & Graves, 2010). A number of taxonomies (Beck, McKeown, & Kucan, 2002; Fisher & Frey, 2008; Harmon, Wood, and Hedrick, 2008; Hiebert & Lubliner, 2008), and instructional approaches have been built on the idea of a general academic that includes high-utility, cross-disciplinary words, none more popular than Beck, McKeown, and Kucan's (2002) tiered scheme. Beck et al. developed a widely used vocabulary selection scheme that advises teachers to select a narrow band of useful general academic words, or tier two words, for instruction from the texts students encounter. Tier two words are words that are uncommon in life outside of school, but common in school texts. Beck et al. estimate that there are only about 7,000 tier two word families, so that teaching just a few hundred each year could contribute to students verbal functioning and reading comprehension in school.

As yet, there is little research to support the efficacy of using academic vocabulary selection schemes to guide vocabulary instruction; the work, which we report later in a section on vocabulary pedagogy, of Snow and her colleagues on word generation (Snow, Lawrence, & White, 2009) serves as a notable exception. Some researchers have questioned the idea that there is a single core vocabulary needed for academic study. For example, Hyland and Tse (2009) asked how well the words found on the widely used Academic Word List (Coxhead, 2000), which includes 570 word families, account for the words in texts that university students encounter across disciplines. They found that the Academic Word List (AWL) in combination with the 2,000 words on the general service list covered about 85% of the words in the corpus they studied, but that this distribution was uneven. Areas that require a more specialized vocabulary, such as science, were not well-covered by the AWL. They conclude that disciplinary words are shaped for highly specialized uses, undermining attempts to construct a core academic vocabulary.

In summary, a number of word-level processes are known to underlie the meaningful reading of connected text, including the ability to manipulate sounds in speech, the ability to leverage a range of strategies for efficiently identifying words, and the ability to associate those words with information about their meaning and uses. Although the community of reading researchers has made significant progress over the past several decades in identifying these processes and understanding how they are learned, questions remain regarding individual variations among learners that impede some from becoming fluent word readers and how to contend with the multitude of words that students must read and understand in order to access school texts.

Text-Level Processes

We turn now to the core of reading processes—text understanding. We deal with several key constructs: construction-integration models of comprehension; the role of context, knowledge, and comprehension; and disciplinary perspectives on reading comprehension.

Construction-Integration Models

If word recognition and word meaning are the point of word level processes, then comprehension is the point of text level processes—and comprehension is infinitely more complex, partially because it entails all of the word-level processes. Successful reading comprehension depends on the proper execution and combination of a large number of cognitive processes. Despite differences in details, the theoretical cognitive models of reading comprehension are rather consistent in many respects (e.g., Goldman, Graesser, & van den Broek, 1999; Ruddell & Unrau, 2004), so we adopt the language and constructs of Kintsch's (1998) Construction-Integration Model to illustrate the general principles of this class of models.[1] Central to comprehension of a text is the construction of a coherent mental representation of the text (van den Broek, 2010). A text can be represented at different levels: a *surface form*, a *text-base,* and a *situation model* (Kintsch, 1998). The surface form representation captures the actual words and phrases of the text. It tends to be short-lived and not strongly related to comprehension per se, as it contains little semantic information. The text-base representation includes the individual propositions/words in the text, together with the referential and other semantic relations that obtain between those propositions. The coherence of the text base depends on the quality of the original text, the reader's accuracy at encoding that text (Cote, Goldman, & Saul, 1998), and the generation of local "bridging"

[1]This description of construction-integration models is based on an account co-constructed by Pearson and Paul van den Broek in a research proposal to the Institute of Education Sciences in 2009 (Wilson & Pearson, 2009).

inferences (e.g., those that resolve anaphoric reference and create cohesive ties, such as causal or time links, among propositions). Finally, the situation model representation captures the information provided by the text, independent of its particular expression, and integrated with the reader's background knowledge. The situation model representation is the most relevant for educational purposes because it constitutes a generalizable and applicable knowledge base. Successful comprehension and the construction of a coherent representation require the development of a highly elaborated situation model (Trabasso, Secco, & van den Broek, 1984). Precisely how much and what prior knowledge becomes integrated in the situation model depends on the text and the reader's prior knowledge but also on the task or purpose of comprehension (van den Broek, Fletcher, & Risden, 1993; van den Broek, Lorch, Linderholm, & Gustafson, 2001). The properties of readers' mental representations can be determined through various outcome tasks, for example, tasks that assess memory for what was presented, others that identify inferences that are warranted by the text in conjunction with general world knowledge, and still others require the application of the information in the text to new situations (Goldman, 1997; Graesser, Gernsbacher, & Goldman, 1997; Kintsch, 2004; van den Broek, 1994). Included in this family of theories are models that characterize text processing and knowledge representations in terms of semantic networks (Anderson, 1983; Trabasso et al., 1984), schemas, frames, and scripts (Anderson & Pearson, 1984; Rumelhart & Ortony, 1977), mental models (Johnson-Laird, 1983; McNamara, Miller, & Bransford, 1991), and dual-coding in verbal and nonverbal systems (Paivio, 1990; Sadoski & Paivio, 2001).

The construction of a mental representation occurs primarily online as the text is read—rather than after reading has been completed. And it is inherently iterative and dynamic, with the situation model changing as new information from the text and new knowledge sources from memory are instantiated moment by moment (Linderholm, Virtue, van den Broek, & Tzeng, 2004). For this reason, much research has been dedicated to identifying the processes, strategies, skills, and background knowledge that readers must have to arrive at a coherent situation model of the text. Using a variety of methods, including speeded responses, reading rate, verbal think-aloud protocols, computer simulations, and, recently, eye tracking and neuro-imaging techniques—considerable insights have been gained in the online process of comprehension. One such insight is that "each new piece of linguistic information is understood in terms of the information it evokes from memory" (Gerrig & McKoon, 1998, p. 69). A crucial aspect of the reading process as it runs its course during reading is that the reader has to achieve a balance between the severe limitations of his/her working memory, or attentional capacity, on the one hand and his/her need to achieve coherence (Kintsch, 2004; van den Broek, Young, Tzeng, & Linderholm, 1998/2004). As a result of limited working memory capacity, only a small subset of the textual information and of background knowledge can be processed by the reader at any particular instant during reading. The selection of information for retention in working memory is a critical determinant of the eventual representation of the text as a whole. Such selection is partly the result of automatic processes (once certain lexical items make it into memory, strong evocations are sure to follow), and partly that of strategic (i.e., reader-controlled and deliberate) processes (e.g., searching for a plausible fit among items in memory) (Thurlow & van den Broek, 1997)

Kintsch's Construction-Integration model (Kintsch, 1988, 1998) captures the interaction between text and knowledge in a two-phase process model. The construction phase is text-based and bottom-up; in that phase, textual information activates background knowledge in an associative and relatively uncontrolled, almost automatic, manner (see also the memory-based model; Gerrig & O'Brien, 2005). The initial activation is followed by a second phase in which activated knowledge and the concepts/ideas in the text are integrated into a coherent mental representation; the product of this integration phase is the situation model. During integration, background knowledge supports connections between and to ideas from the texts, and provides the foundation for inferences. This balancing act by the reader implies that the complex cognitive processes require coordination and regulation: Readers may strategically search and reactivate information from the preceding text (from memory or by reinspecting the actual text) and/or strategically search and activate background knowledge (van den Broek, 1990). Effective readers know when their efforts at comprehension require such strategic interventions and what constitutes appropriate, corrective steps (Baker & Brown, 1984; Cote et al., 1998).

Coordinating Cognitive Processes

These examples illustrate the extent to which reading comprehension requires the coordination of various cognitive processes and skills. Individuals can differ considerably in these processes and skills. As noted, they depend on efficient attention allocation strategies that select information that is likely to serve as an appropriate context for the integration of new information in a text. They depend on the availability of working memory capacity to hold the selected information until it has been processed adequately. They depend on rapid, automatic access to long-term memory so that connections are recognized between currently processed information and relevant information encountered much earlier in a text, or to make connections between information presented by the author and relevant background knowledge possessed by the reader (van den Broek, Bohn-Gettler, Kendeou, Carlson, & White, 2011).

Moderating Contextual Effects

To some extent, the skills and processes required for successful reading in these illustrations apply to all contexts in which reading takes place. However, their implementation is strongly influenced by the context—for example, the text genre, the subject area of the text (history versus physics or literature), and the reader's goals (Kintsch, 1998). Moreover, readers must apply context-appropriate strategies. For example, different types of text invite different purposes, possess different structures and features, and revolve around different types of information: Narratives revolve around characters in specific situations and with specific goals, whereas exposition revolves around the development of topics that may be related in many different ways. Moreover, they differ in the kind of background knowledge that may be helpful in comprehending the text. In this sense, discipline-specific background knowledge includes both *content* knowledge (i.e., background knowledge about the topics in the text) and *strategic* knowledge (which standards of coherence are appropriate to this discipline and its default reading goals, what processes are appropriate given the particular text genre/structure, how this influences effective allocation of attention and processes such as memory search, what text-processing signals are present in this discipline). An important implication is that a reader's background knowledge, understanding of a specific text genre, knowledge of situation-dependent strategies, and other considerations all influence the extent to which the reader will be able to construct a coherent representation. Thus, the reading comprehension skills of a reader vary and then converge to allow her to construct an understanding while reading a particular text for a particular purpose (van den Broek et al., 2011).

In addition to the cognitive processes enacted during reading comprehension, a reader needs to possess basic language and reading skills such as letter- and word-identification, syntactic knowledge. A certain level of mastery of these skills is necessary for comprehension to occur; such mastery allows for automatic, or at least facile, translation of the symbols in the text into the propositions that will constitute the basis for constructing models at all three levels—the surface form and the text base and situation model. In addition, if the basic language and reading skills consume considerable working memory capacity, then the capacity available to the comprehension processes themselves will be severely limited (Perfetti, 1999), rendering the construction of the situation model in particular more difficult. However, these skills are themselves not enough to produce comprehension of the text as a whole. Thus, word and sentence level skills are necessary but insufficient for adequate comprehension. Recent investigations of the developmental trajectories of language comprehension skills and basic language skills, respectively, confirm this view (Gough & Tunmer, 1986; Kendeou, Savage, & van den Broek, 2009; Whitehurst & Lonigan, 1998). In longitudinal studies, the two sets of skills—those pertaining to basic language and language comprehension skills, respectively have been found to develop relatively independently from preschool into the early primary grades and, then, combine to predict reading comprehension in the later grades (Kendeou, van den Broek, White, & Lynch, 2007, 2009; Oakhill, Cain, & Bryant, 2003; van den Broek, White, Kendeou, & Carlson, 2009). As a matter of practice, then, monitoring and teaching both sets of skills and strategies in their own right seems necessary; indeed, the research on pedagogy reviewed in other parts of this chapter suggests exactly that.

Knowledge—A Multilayered Construct

Knowledge, as represented in long-term memory, is key to the comprehension process. Its role in the integration phase of building a situation model is transparent, as the ideas from the emerging text-base trigger or instantiate precisely those schemata from long-term memory required to build that coherent representation of text we call the situation model. Many of the schemata that are triggered in this process will be ideas about the topic, domain, or discipline in which the text resides. But many other kinds of knowledge are also implicated. For example, knowledge about language at virtually every level of analysis—phonological, morphological, lexical, semantic, syntactic, and pragmatic—can and will be engaged in building both a situation model and, equally as important, in establishing the cohesion among sentences (e.g., resolving anaphora or logical relations among sentences) that distinguishes a text-base from the mere surface form of a text.

But also important will be knowledge about text—what it is and how it works. Text knowledge includes everything from (a) the conventions of a particular orthography and how they map onto the phonological code required for accessing the lexicon to (b) knowledge of the genres that typify a subject matter like geography—what they are how they work to (c) small but significant matters such as text features—headings, visual displays, lists, captions, indexes, and the like.

Strategic Knowledge

One type of knowledge plays a very special role in reading comprehension—strategy knowledge. As we suggested earlier, readers use strategies throughout the comprehension process as they engage in intentional searches of the text-base and their knowledge structures at points in the process of building a situation model. Most commonly, strategies are invoked precisely when the automatic processes of constraint satisfaction (making sure that the current version of the situation model satisfies the informational constraints coming from the text base and the knowledge base) are not working well (van den Broek et al., 2011). Many readers develop these strategies for "free" in the sense that they pick them up along the way by just reading a lot. Other readers require more intentional efforts on the part of schools and teachers in order to use strategies effectively; Kintsch (2004) discusses the high likelihood that many if not most novice readers will require explicit instruction and modeling in using these strategies. But strategy use is not solely the province of novice or poor readers. To the contrary, expert readers are highly competent strategy users; it is just that their strategy use is so fluent, so "skilled" in the sense of having reached an automatic level of operation, that we do not see it in action very easily or often. But put those expert readers in a situation where they are forced to use them (a really difficult or unfamiliar text) or ask to use them (as in a think-aloud protocol), and a well-elaborated, well-articulated strategy infrastructure is readily revealed (Alexander, 2003, 2005). This does not mean that these strategies are necessarily a normal part of the everyday reading process for them (i.e., when readers are experiencing nothing but the automatic "clicks" of comprehension), but it does mean that they are always there to assist in case a comprehension "clunk" (Klinger & Vaughn, 1999) has just been or is about to be experienced.

Disciplinary Perspectives on Reading

In recent years, the dominant view of reading as a set of general skills that can be applied to a variety of texts, purposes, and disciplines has been challenged by research and theory suggesting instead that reading is dependent on the nature of texts and disciplinary practices in which it is situated. This shift in perspectives on reading is attributable in part to the genre movement discussed below. However, it has also been precipitated by concerns that a decade-long focus on "basic" reading skills, including generalizable comprehension skills and strategies, failed to produce a generation of students who were prepared in adolescence or adulthood for the demands of discipline-based reading.

Several recent reports on reading and adolescent literacy have called for attention to text- and discipline-specific reading practices (e.g., Alliance for Excellent Education, 2010; Heller & Greenleaf, 2007; Rand Reading Study Group, 2002). In fact, it can be argued that the recently developed Common Core Standards privilege just such an approach with the inclusion of separate standards strand for literature, history, and science (and technical subjects). These reports point to the need not only to continue to support students' development of literacy skills beyond the early elementary years, but also to support students in learning to read and write in ways that will specifically foster involvement in disciplinary learning (Alliance for Excellent Education, 2010; Common Core Standards, 2010; Heller & Greenleaf, 2007; T. Shanahan & Shanahan, 2008).

Texts. The most obvious difference in reading as students move into different disciplinary context concerns the nature of the texts (van den Broek, 2010). Texts that students encounter in history are quite different from those than they encounter in chemistry (Carnegie Corporation of New York's Council on Advancing Adolescent Literacy). Lee and Spratley (2010) note that scientific reports and textbooks include vocabulary and syntactic forms that can be difficult for inexperienced readers (see also Snow, 2010). In addition, these texts often include features, such as abstracts, headings, and diagrams, which can support understanding if students are taught to use them. The recent reports on adolescent literacy generally express concern that the emphasis on generic reading comprehension strategies may lead students to conclude that all content-area texts can be approached the same way such that reading in math is identical to reading in history (Heller & Greenleaf, 2007). The authors of the Carnegie report, *Time to Act* (2010), conclude that students should be taught skills and strategies for reading texts in each content-area. The Rand Reading Study Group (2002) goes further, suggesting that discipline specific reading comprehension tasks must be learned in the context of learning the content of the discipline and participating in disciplinary inquiry.

Skills and Processes. Although systematic variations in text content and organization are the most visible difference in reading across content areas, T. Shanahan and C. Shanahan (2008) point out that the move into disciplinary reading involves more than the application of generalized reading skills to new texts; it involves the use of more sophisticated and specialized skills and practices. Interest in the lexical, syntactic, and organizational characteristics of content area texts and the challenges that these present to students is not new (Osborne, 2010; Snow, 2010). What has come to the fore in recent decades is interest in discipline-specific inquiry practices and methods of communication, and how these are reflected in uses of language, the organization of texts, and the relationships between texts and ways of developing knowledge (Heller & Greenleaf, 2007; Moje, 2008). The turn toward a disciplinary view of literacy also reflects a recognition that literacy is an essential part of any disciplinary practice rather than merely a means of improving students' reading of content-area textbooks (Moje, 2008). Heller and Greenleaf point out that:

> To become competent in a number of academic content areas requires more than just applying the same old skills and comprehensions strategies to new kinds of texts. It also requires skills and knowledge and reasoning processes that are specific to particular disciplines. (p. 10)

Empirical and theoretical work in disciplinary literacy has started to identify how literacy practices differ across disciplines and how these differences are related to the nature of the disciplinary practices. For example, T. Shanahan and Shanahan (2008) examined the reading processes of disciplinary experts as they read and thought about texts in their areas. The researchers found that the experts in each discipline approached texts differently and leveraged a different set of reading strategies. For example, whereas historians attended to possible sources of bias, mathematicians engaged in close examination and rereading of the text qua text, to ensure they understood the contribution of each word to the meaning, and scientists tended to examine the credibility of the work that lay behind the text (who produced, where, and for what purpose).

T. Shanahan and Shanahan (2008) suggested that differences in the reading practices of disciplinary experts are related to the values, norms, and methods of scholarship within each discipline. That is, historians read for the author's perspective, because historical scholarship is characterized by retrospective analysis of source documents and thus risks selective analysis and biased interpretation. Because chemists build knowledge through experimentation, they read to understand the procedures used to obtain particular results.

Leinhardt and Young (1996) asked three expert historians to read and interpret two historical documents, one of which was close to and one far from their area of expertise. The researchers found that historians engaged in classification (identifying the type of document), corroboration (checking the accuracy of a document by looking for consistency across the text and with other texts), sourcing (identifying things like authorship, publication date, and location to uncover the nature and influence of the bias that is assumed to be part of every historical document), and contextualization ("asking what else was happening when and where the document was written by locating it historically in terms of prior, coincident, and consequential events").

Wineburg (1991) examined the reading practices of historians and high school students as they read a set of historical documents about the American Revolution. He found that historians, unlike high school students, move beyond a literal reading of history texts to approach them as both rhetorical artifacts and as human artifacts. When approaching texts as rhetorical artifacts, historians consider authors' purposes, intentions and goals, and the ways that the authors use language for persuasive purposes. In approaching texts as human artifacts, historians examine how texts reveal information about authors' views and beliefs. The historians also engaged in conversations with the texts that extend beyond the author-reader dialogue to include different reader stances and audiences. Wineburg attributed differences in the ways historians and students read the texts to different epistemological beliefs about historical inquiry. Students approached texts as the bearers of information and approaches reading as a process of information gathering, whereas historians viewed the texts as human creations and social exchanges. For students, the connection between the author and the text was scarcely a consideration in their reading.

In this section, we have discussed the many factors—from knowledge and reparative strategies to text and context—that influence a reader's ability to make meaning as they read. Taken together with the underling word level processes, a picture of the complexity of reading, and by implication the complexity of learning to read, begins to emerge. In the next section, we transition to the learning to read perspective by examining the research on the role of instruction in helping students gain mastery of the many processes and understandings that comprise expert reading.

INSTRUCTIONAL CONTEXTS FOR READING DEVELOPMENT

We turn now from research about processes to research about the intentional acquisition of those processes, namely curriculum and pedagogy. The sections within this section parallel those in the previous section on basic processes.

Word Level Instruction

An important benchmark in shaping instructional practices for word level processes—and for early reading instruction more generally—was Marilyn Adams' 1990 book, *Beginning to Read: Teaching and Learning about Print*. It provided a complete synthesis of our pre-1990 knowledge base about basic reading processes and the processes of reading acquisition. Sponsored by the then Office of Educational Research and Improvement, it was the third in a long line of national syntheses about how best to teach the basic components of early reading, preceded historically by Chall's 1967, *Learning to Read: The Great Debate*, and Anderson, Hiebert, Wilkinson, and Scott's 1984, *Becoming a Nation of Readers*. It is a benchmark because it appeared in the field at the height of the surge of constructivist reforms of the era, most notably whole language and literature based reading (see Pearson, 2004, for a detailed summary of this era) and preceded the return to an early emphasis on the code that began about a half decade later. While causal inferences are unwarranted, it is certainly likely that Adams' book provided a ready and credible knowledge base for those wishing to move back to an earlier and more consistent early code emphasis.

In 1998, another national synthesis, this time commissioned by the National Academy of Science, resulted in Snow, Burns, and Griffith's *Preventing Reading Difficulties*. It is distinguishable from Adams' synthesis in taking on a much broader research and policy agenda (e.g., mainstream instruction, instruction for struggling students, preschool, early reading, teacher education, and professional development) but to a somewhat narrower end (i.e., preventing reading difficulties through early interventions of various sorts). The past decade ushered in two additional syntheses, the 2000 National Reading Panel Report (NICHD, 2000) and the National Early Literacy Panel of 2008.

Code-Focused Instruction, and More

Across the last four syntheses, beginning with Adams' book, a remarkably consistent message has emerged, based on the then available research. The conclusions and recommendations differ only in particular details, which are driven most likely by additional research insights undergirding each report. All four reports, for example, converge on an early emphasis on the code, opting for systematic phonics instruction (of no particular variety—analytic and synthetic are not privileged over one another) early in K–1. That phonics instruction should be accompanied by instruction in phonemic awareness (hearing the separate sounds in spoken words), with a nod going approaches that link phonemic awareness to specific letter sound correspondences and do not dally for too long on the process). And all of these word-level skills, according to all of these reports, should be situated within a language rich, balanced literacy program that promotes word-level and text-level expertise and general language competence and world knowledge. We mention these latter recommendations because these reports, especially the National Reading Panel (NRP), often get labeled as *code-based* or at least *skill-based* policy documents when, in fact, their recommendations tend to be much more balanced than their public reputation.

The National Early Literacy Panel

The review of interventions in the National Early Literacy Panel (2008) deserves elaborated consideration because it is quite comprehensive and, in comparison to earlier syntheses, comes with the added benefit of research conducted in the era of No Child Left Behind (NCLB). In a nutshell, the NELP identified five interventions that achieved moderate to large effects on student literacy outcomes. Like earlier reports, NELP found strong effects for code-focused instruction, both phonemic awareness training and early phonics instruction on a range of early literacy outcomes. Like the Preventing Reading Difficulties (PRD) report of 1998, it also found enduring effects for language-enhanced programs, primarily on oral language development. But unlike earlier syntheses, it found additional effects for book-sharing programs (on print knowledge and oral language), home and parent programs (on oral language and general cognitive abilities), and comprehensive preschool and kindergarten programs (on spelling and reading readiness skills). In other words, NELP expanded beyond the traditional word and within word foci to include a range of contextual variations in pedagogy, with the result that both word level (e.g., alphabet knowledge, phonemic awareness, and letter sound correspondences) and meaning level (oral language and cognitive abilities) were enhanced.

Earlier national syntheses identified most of these categories of interventions as useful in developing students' literacy background and capacity for benefiting from instruction (Adams, 1990; Snow et al., 1998). However, no previous effort had collected *all* of the available evidence on *all* of these programs and examined it through the lens of meta-analyses. It is encouraging to early literacy experts to know that this range of interventions make a consistent difference in profiles of student achievement on valued early literacy outcomes. Pearson and Hiebert, in reviewing NELP in 2010, noted that another unique finding from NELP was these five general programmatic categories tended to influence different sorts of outcomes, suggesting a kind of "specificity" of effects, a phenomenon that often influences instructional research in general (see Moran, Ferdig, Pearson, Wardrop, & Blomeyer, 2008, for a vivid example of this specificity phenomenon).

Vocabulary Instruction

A wealth of instructional studies during the 1980s and 1990s demonstrated that the meanings of words can be taught through a wide assortment of approaches. In 2000, the National Reading Panel (NRP) emphasized the importance of vocabulary instruction, but did not find sufficient evidence to recommend some methods of instruction over others. The NRP's analysis did synthesize the findings of previous research to identify *characteristics* of successful vocabulary instruction, including opportunities for students to encounter target words multiple times in meaningful contexts and to use the words actively. A decade earlier, Stahl and Fairbanks (1986) had famously found that instruction of word meanings in context is more effective than no-context instruction of word meanings. The NRP also confirmed the effectiveness of direct instruction of at least some words as a supplement to exposure through wide reading.

Many vocabulary instruction experts recommend a multicomponent approach to developing vocabulary knowledge. For example, Graves (2000) has advocated a four-part program that includes:

1. Teaching individual, high-utility words.
2. Wide reading.
3. Teaching word-learning strategies, including morphology.
4. Fostering word consciousness, an interest in words.

A significant recent development in vocabulary research has concerned instruction of generative word learning strategies that allow students to more readily acquire knowledge of new words. In part as a response to the aforementioned volume problem in vocabulary instruction has been interest in identifying effective practices for supporting students' incidental learning of new vocabulary from reading and listening. While in the past there has been a tendency to think about vocabulary knowledge as "consisting of isolated, memorized information about the meanings of specific words," this conception has been come to be seen as inadequate (p. 29). Vocabulary researchers are seeking ways to teach knowledge and dispositions that increase the likelihood that children will learn new words on their own. The most notable of these is the work on instruction about the morphological structure of words.

Morphology

A growing line of work on generative word knowledge has considered the role of morphological knowledge—knowledge of small, meaningful units of language, including roots and affixes—in acquiring knowledge of new words. The question underlying this work is whether students are able to infer the meanings of new words through the analysis of the words' meaningful parts. Morphological knowledge has long been identified as part of the explanation for how students acquire new vocabulary knowledge (Carlisle, 2007; Nagy & Anderson, 1984). It has also been known for some time that morphological awareness is related to size of vocabulary and reading comprehension. Morphological awareness has recently been associated with several additional components of literacy development, including decoding and spelling, vocabulary, and reading comprehension (Carlisle, 2010).

The research on the utility of teaching morphological analysis has been limited (Baumann, Bradley, Edwards, Font, & Hruby, 2000), but in recent years, there has been an interest in whether morphological instruction can support word learning (Carlisle, 2010), and a growing body of evidence that students can use knowledge of meaningful word parts to solve the meanings of novel words containing the same parts.

Several studies have explored the efficacy of instruction in morphological analysis. Baumann, Edwards, Boland, Olejnik, and Kame'enui (2003) compared the effects of morphemic and contextual analysis instruction (MC) with textbook vocabulary (TV) instruction on fifth-grade students' vocabulary learning and reading comprehension. Students in the TV group were taught specific words from the textbook, while MC students received instruction in morphemic and contextual analysis strategies using example words from the textbook. Students who were directly taught the vocabulary words made stronger growth on a test of those words, but students who received the MC intervention made stronger growth in their abilities to decipher the meaning of new morphemically decipherable words in isolation and (on a delayed but not immediate posttest) in context. There were no differences in comprehension growth.

Bowers and Kirby (2010) examined the impact of an intervention focused on teaching morphological word structure to fourth and fifth graders. Students who received the morphological instruction were better able to identify base words in new words and better able to define taught and new words as long as the new words were within taught morphological families.

Teaching Academic Vocabulary

One recent instructional program of direct teaching of target words that has demonstrated effectiveness in middle school is the Word Generation program (Snow et al., 2009). Snow et al. describe the program as it was implemented with students in grades 6 through 8. The program, which focused on teaching high-utility academic words, involved students in encountering words repeatedly in semantically rich and varied contexts. It also offered opportunities for students to use the words actively in talk and writing. Students in the word generation classrooms made greater gains in their knowledge of the instructed academic vocabulary words than students in control classrooms, and there was some evidence that participation also positively impacted students' standardized state English language arts test scores.

Text-Level Instruction

Beginning in the 1970s, research on improving text level comprehension has been an active area of pedagogical scholarship, with a wide range of synthetic reviews and meta-analyses (e.g., Duke & Pearson, 2002; Duke, Pearson, Strachan, & Billman, 2011; Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009; Pearson & Fielding, 1991; Pressley, 2000; Tierney & Cunningham, 1984; Wilkinson & Son, 2011). Looking across the substantial body of research and at the key syntheses, several consistent findings emerge, although none of them comes with what would be judged a strong evidence base (e.g., as defined by the What Works Clearninghouse). Consistently emerging in these reviews are several interventions that could be labeled comprehension fostering (after Palincsar & Brown, 1984, and recently reinvoked by Duke, et al., 2011) to capture a set of practices that are less about direct instruction of comprehension processes, skills, or strategies and more about facilitating comprehension though other activities in the school environment—practices such as numbers 2, 3, 6, 8, 9, and 10 in this list from Duke et al., 2011) in the list below. The others (4, 5, 7, and perhaps 1) come closer to what we have in mind when we talk about direct comprehension instruction, but even building disciplinary knowledge and promoting vocabulary growth have as much of a *fostering* as they do a *teaching* patina to them.

1. Build disciplinary and world knowledge.
2. Provide exposure to a volume and range of texts.
3. Provide motivating texts and contexts for reading.
4. Teach strategies for comprehending.
5. Teach text structures.
6. Engage students in discussion.
7. Build vocabulary and language knowledge.
8. Integrate reading and writing.
9. Observe and assess.
10. Differentiate instruction.

For our purposes, we have divided this research into four categories: (1) discussion as a medium for promoting text comprehension; (2) reading strategy instruction; (3) instruction in text structures, including genres; and (4) instruction embedded in the pursuit of acquiring disciplinary knowledge. It should be noted that the evidence for comprehension instruction, be it fostering or teaching, is not limited to the intermediate and secondary levels of schooling. To the contrary, Shanahan et al. (2010) were able to document five practices with various levels of empirical evidence to support their efficacy: (1) strategy instruction, (2) using text structure to organize learning, (3) discussion, (4) selecting texts to support comprehension, and (5) establishing an engaging and motivating classroom context for supporting comprehension. Only strategy instruction earned a strong evidence rating, while text structure and providing an engaging context earned a moderate evidence rating. Discussion, and text selection earned a weak evidence rating. A weak evidence rating is a bit misleading in this context because these practices, while not possessing anything like randomized field trial evidence to assess their efficacy, at least (and unlike a host of highly recommended and widely implemented practices with absolutely no evidence to evaluate their efficacy) have been evaluated in either correlational or nonrandomized experimental studies.

Talk About Text

Reading comprehension instruction has been heavily influenced by understandings about the role of social interaction in learning. Following in the tradition of Vygotsky (1934/1987), who suggested that higher order cognitive functions develop first in the social sphere, many approaches to comprehension instruction focus on discussion of text as a key aspect of learning to develop the cognitive habits of highly skilled readers. Discussion-oriented approaches reflect the idea that talk not only helps students to internalize expert ways of interacting with text, but also helps readers to clarify and consolidate their learning from text.

The positive effects of thoughtful and cognitively challenging discussion on reading achievement have been documented in a wide array of studies (e.g., Gambrell & Morrow, 1996; Kong & Pearson, 2003; Raphael & McMahon, 1994; Taylor, Pearson, Peterson, & Rodriguez, 2003). In addition, numerous instructional routines for text-based discussion have been described in the reading research and practice literatures. These include Book Club (Raphael, Florio-Ruane, & George, 2001; Raphael & McMahon, 1994); Questioning the Author (Beck & McKeown, 2006); Instructional Conversations (Goldenberg, 1993; Rueda, Goldenberg, & Gallimore, 1992; Tharp & Gallimore, 1991); and Collaborative Reasoning (see Clark et al., 2003).

These instructional routines can all be described as a set of strategies, or moves, which can be used flexibly by teachers to encourage talk that invites students to share their reasoning and grapple with cognitively challenging ideas. In all of these frameworks it is expected that students will assume a degree of control over their own learning over time, and that they will work toward improving their peer conversations through intentional reflections.

In addition, these approaches generally share a focus on teacher as coach and guide. The teacher's role is not to provide answers but instead to model the language of academic discussion for students through clarifying, mediating turn taking when necessary, and probing students to think even more deeply about relevant aspects of the text.

Soter et al. (2008) reported the results of a study designed to evaluate the relative efficacy of nine discussion routines. In addition to those mentioned above, Soter et al. examined Grand Conversations (Eeds & Wells, 1989), Literature Circles (Short & Pierce, 1990) Junior Great Books (Great Books Foundation, 1987), Philosophy for Children (Sharp, 1985), and Paedia Seminar (Billings & Fitzgerald, 2002). Soter et al. identified features of classroom discourse that indicate high-level thinking and comprehension. These included the posing of authentic questions by teachers and students; students' elaborated responses, questions, and reasoning language; and the presence of uptake by teacher and students. The researchers then used the features to analyze samples of student discourse resulting from each of the nine discussion routines. The researchers found that critical-analytic approaches, such as Collaborative Reasoning and Philosophy for Children, and the expressive approaches, such as Book Club and Grand Conversations, invited the most high-level thinking and reasoning by students. These approaches involved a high incidence of authentic questions, elaborated explanations, and uptake.

In a related meta-analysis, Murphy et al. (2009) found that the impacts on students' comprehension were inconsistent. In particular they found that, while many of the discussion routines promoted students' literacy and inferential comprehension, there was great variability in the degree to which different routines promoted high-level comprehension of text (e.g., critical thinking, reasoning, and argumentation). Only a few of the routines (Collaborative Reasoning, Philosophy for Children, and Junior Great Books) were effective at increasing both literacy comprehension and higher-level comprehension in multiple-group design studies.

Although Soter et al. (2008) looked only at discussions of literature, there is some evidence that involvement in discussions about text supports content-area learning by, for example, supporting conceptual understanding in science (Palincsar & Magnusson, 2001), inviting all readers to employ reading strategies (Chinn, Anderson, & Waggoner, 2001), and even increasing the efficacy of comprehension strategy instruction (Berne & Clark, 2008).

Comprehension Strategy Instruction

Reading comprehension in U.S. classrooms is largely taught through instruction and practice with comprehension strategies, such as predicting, clarifying, activating prior knowledge, summarizing, and questioning. The rise of comprehension strategy instruction in recent decades has been grounded in substantial research demonstrating that high-achieving readers use more strategies than low-achieving readers (Block & Pressley, 2002; Dole, Duffy, Roehler, & Pearson, 1991; Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007)). Strategy instruction emerged from the understanding that good readers are thoughtful about their own understanding (or lack of understanding) and skilled in developing plans for fixing comprehension when it goes awry.

In addition, the ascendancy of strategy instruction in the reading curriculum has been bolstered by a vast body of correlational and intervention studies that have supported the value of comprehension strategies. These studies have consistently demonstrated that students who are explicitly taught to use comprehension strategies can apply them with the result of improved comprehension and can transfer the strategies to the comprehension of new texts (Brown, Pressley, Van Meter, & Schuder, l996; Paris, Lipson, & Wixson, 1994; see also Dole, et al., 1991; Duke et al., 2011; Duke & Pearson, 2001, 2002; Pressley, 2000; Rosenshine & Meister, 1994).

The particular configuration of cognitive and metacognitive strategies for reading varies across studies and research syntheses, but the list from the National Reading Panel (NICHD, 2000) report is a good representation of the core set of strategies. This list includes: comprehension monitoring, cooperative learning, graphic organizers, story structure, question answering, question generation, and summarization. There are also several major strategy "suites" in reading instruction, which combine multiple strategies into a coherent approach. These include Reciprocal Teaching (Palincsar & Brown, 1984; Rosenshine & Meister, 1994) and Transactional Strategies Instruction (Brown et al., l996).

In response to the question of how to teach strategies, Duke and Pearson (2002) offer a set of steps that typically occur in effective explicit strategy instruction across scores of instructional studies:

- Naming and describing the strategy—why, when, and how it should be used.
- Modeling the strategy in action—either by teacher or student, or both.
- Using the strategy collaborative—in a sort of group think-aloud.
- Guiding practice using the strategy with gradual release of responsibility.
- Using the strategy independently, with no teacher guidance, either individually or in small student-led groups.

For more than two decades there has been broad consensus that strategies should be taught, along with agreement about which strategies matter most (Duke & Pearson, 2002). In the past few years, and in light of the emergence of attention to nonfiction text genres, cracks have emerged in the consensus around comprehension strategy instruction. For example, most studies of strategy instruction have focused on comprehension of fictional texts and has been conducted in the context of English language arts instruction, but Vitale and Romance (2007) suggest that research on comprehension strategy instruction lacks ecological validity for science reading because it fails to situate comprehension in forms of content-area learning that require cumulative meaningful understanding. Likewise, Fisher and Frey (2008) express concern that the preoccupation with strategies is making strategies, rather than texts, the focus of reading instruction. While not faulting strategy instruction itself, Pearson (2011) points out that the dynamic and responsive character of strategy use has sometimes been lost as it is encoded in commercial reading programs. That is, strategy use has sometimes become an end unto itself, rather than a set of tools for achieving and repairing comprehension. McKeown, Beck, and Blake (2009), in a direct comparison with of strategy instruction with content focused instruction (what might be construed as a "rich talk about ideas in the text" approach), found that content treatment resulted in better performance on narrative recall and expository learning probes. The strategy instruction group was indistinguishable from a basal driven control group (and the control group actually exceeded the strategy group on a couple of measures given along the way). In addition, Wilkinson and Son (2011) point out, while we know that comprehension strategy instruction improves comprehension, two decades of research has failed to identify the optimal set of strategies or even the optimal number of strategies. The most obvious explanation for the efficacy of strategy instruction is that instruction increases the use of strategies, and strategies increase understanding of text (Pressley, Brown, El-Dinary, & Afflerbach, 1995). However, it may simply be that strategic (focused and intentional) behavior in general, rather than any set of particular strategies, matters most. Following W. Kintsch and Kintsch (2005), Wilkinson and Son note that a common feature of all comprehension strategies is that they support students in actively constructing meaning as they read and invite readers to connect texts with their prior knowledge. It may be that that these underlying activities, rather than any particular strategies, are key ingredients of comprehension.

Genre and Text Structure Instruction

In the 1990s interest in text genre began to take hold in North America, although it had been alive and well in Australia (see Cope & Kalantzis, 1993) since at least the early application of functional systemic linguistics (Halliday, 1961) to pedagogy and curriculum. Some reading educators in the United States had become concerned about the emphasis on "authentic" fictional literature had excluded attention to other text genres, particularly nonfiction text genres. Motivated in part by suspicions that literature-based programs were failing to support vocabulary development, and that reading instruction was failing to prepare students for the texts and tests of later schooling (Rand, 2002), advocates of greater emphasis on informational text argued that the balance of texts in early reading should reflect the balance of texts that students will encounter as they continue in school and the texts that they will read in their lives outside of school—contexts dominated by nonfiction text genres (e.g., Duke & Bennett-Armistead, 2003).

At the same time, the rise of standards-based education and the increased emphasis on annual testing in reading heightened educators' interest in expository reading and writing, particularly as concern surfaced that the "fourth grade slump" might be attributable in part to lack of preparation for informational reading in grades K–3 (Moss, 2005). The rapid rise of in interest in the use of informational text in the elementary grades at the turn of the century is evident in professional publications for teachers. Moss (2005) analyzed the topics of articles appearing in the most prominent practitioner-oriented reading journal, *The Reading Teacher*, between 2000 and 2004. Moss found that, unlike during preceding decades, most articles clustered around two topics, one of which is the uses of informational trade books.

The new movement to include a greater diversity of genres, especially informational genres, in early reading instruction was accompanied by a move away from a generalist view of reading, in which reading is understood as a set of skills that can be applied to any text (T. Shanahan & Shanahan, 2008). As a result, advocates of informational text wanted not only to change the relative balance of text genres in elementary classrooms, they also wanted to reshape instruction to reflect the fact that different genres of texts should be read differently—that reading comprehension is dependent, in part, on an understanding of genre characteristics, such as text structure and text features. Reading educators came to believe that different types of texts required different understandings, skills, and strategies, and, therefore, required different forms of instruction. The 2002 Rand report, *Reading for Understanding*, reflected this view, noting that "the features of text have a large effect on comprehension" (p. 14). Research has supported the idea that some text genres are more difficult to comprehend than others. For example, Best, Floyd, and McNamara (2008) examined decoding and world knowledge as factors in third graders' comprehension of narrative and expository texts. They found that students' comprehension scores (multiple choice, free recall, and cued recall) were lower for an expository science text than for a narrative story. Scores on all three comprehension measures were predicted by world knowledge for the expository text, but decoding ability was a more consistent predictor of comprehension for the narrative text.

Although genre is more appropriately thought of as a set of functional distinctions than organizational ones, much of the instructional work has focused on two salient organizational aspects of text genre—text structures and text features. As such, we address each of these separately, starting with text structure. Research has also supported the idea that some students are more aware of some text structures than others (Englert & Hiebert, 1984) and that this awareness is related to students' comprehension of text (e.g., Taylor & Samuels, 1983). Richgels, McGee, Lomax, and Sheard (1987), for example, found that sixth-grade students demonstrated better awareness of comparison/contrast, collection, and problem/solution text structures than causation structures. Meyer, Brandt, and Bluth (1980) found that ninth-grade students' awareness of and use of text structure in organizing a recall from text was strongly related to the amount of information that the students recalled.

Given the role of text structure awareness in comprehension of expository texts, it stands to reason that providing instruction in text structures might improve students' comprehension. Evidence on this score is mounting. Historically, in the late 1970s and 1980s, there was a short-lived but powerful burst of research on text structure instruction (see Pearson & Camparell, 1981, for an extensive review). More recently, attention to text structure has resurfaced with a resurgence in interest prompted, at least in part, by the Rand Report (2002) and, even more recently, by the What Works practice guide on reading comprehension in the primary grades (Shanahan et al., 2010). The conclusions of the What Works panel suggested that teaching students to use story maps while reading narratives (Baumann & Bergeron, 1993; Morrow, 1984, 1996; Reutzel, Smith, & Fawson, 2005; Williams et al., 2007) or particular expository structures, such as cause-effect (Reutzel et al., 2005; Williams et al., 2007), while reading expository texts yields moderate effects on reading comprehension. The text structure instructional research typically pairs text structure instruction with other instructional practices, such as comprehension strategies that are tailored to the text structure or discussion focused on the content. This sort of practice undoubtedly strengthens the pedagogical package, but such confounding makes it impossible to isolate the variable or variables in the package that might be serving as the *active ingredient(s)*. Thus we can conclude only that text structure instruction, when offered in concert with X, or Y, or Z, has a positive impact on text comprehension.

A study by Williams et al. (2005) serves as a typical and well-designed example of text structure instructional research. They tested an instructional program for second graders designed to teacher them to comprehend compare-contrast expository texts. Compared with a content-focused condition and a no-instruction control, second graders who received the compare-contrast instruction improved in their ability to comprehend novel compare-contrast texts based on novel content.

The evidence regarding another aspect of text genre, text features, is less clear. Common features of expository texts include things like photographs with captions, tables of contents, timeless verbs, and bolded specialized vocabulary words. While a whole host of recent articles in practice-oriented reading journals advocate the teaching of expository text features (e.g., Bluestein, 2010; Fisher, Frey, & Lapp, 2008; Kelley & Clausen-Grace, 2010), more research is needed regarding the efficacy of this approach on reading. Purcell-Gates, Duke, and Martineau (2007) examined the role of explicit explanation of genre functions and features on second- and third-graders' reading and writing of the genres. Neither access to explicit explanation or explicitness impacted students' reading growth. However, having authentic purposes for the use of reading and writing—reading to learn or investigate; writing to record and communicate—supported students' growth in reading and writing informational text genres.

One promising approach to exploring genre-related text features with teachers and students follows a systemic functional linguistics perspective (SFL; Schleppegrell & de Oliveira, 2006). SFL views the construction of texts and their grammars as related to contextual expressions of meaning. Schleppegrell and colleagues (Schlepegrell & de Oliveira, 2006; Fang & Schleppegrell, 2010) have applied this perspective to the teaching of content-areas as a means for helping teachers recognize the linguistic challenges of content-area texts.

Text Accessibility

A growing body of scholarship centers on the construct of *text accessibility*, that is, the factors that allow readers to read with accuracy, fluency, and comprehension. Scholarship around the construct has accelerated in recent years, driven at least in part by the central role played by text complexity in the recently developed and soon to be implemented Common Core Standards for English language arts (2010). Two major approaches have emerged for gauging a text's accessibility: readability formulas (Klare, 1984) and leveling systems (e.g., Chall, Bissex, Conrad, & Harris-Sharples, 1996)—and a third, more multidimensional approach involving several more nuanced linguistic features is on the horizon (see Graesser, McNamara, & Kulikovwich, 2011).

Readability Formulas. A variety of readability formulas are in wide use by educators and publishers as a means of selecting or guiding the development of accessible texts for particular readers. To this end, a long tradition of research has identified factors that can influence the success a particular reader may have with a particular text (see Klare, 1984, for a review). The most robust of these factors—those that appear in nearly all readability formulas—are an index of word difficulty and an index of sentence complexity. For words, word length often serves as an alias for a deeper index of difficulty, for example, frequency of use in the language or conceptual complexity. For sentence complexity, sentence length often serves as an alias for a deeper index of complexity, for example, number of embedded clauses or propositions per sentence. (Chall & Dale, 1995; Fry, 1977; Smith, Stenner, Horabin, & Smith, 1989; Spache, 1953).

Readability formulas have the benefit of being objective, highly replicable, and correlated with outcomes on reading achievement tests (Fry, 2002). The Lexile approach (Smith et al., 1989), currently quite prevalent in schools, has the further advantage of being applied to an extremely large corpus of texts. Moreover, it purports to place both text difficulty and student achievement (as measured by standardized tests) on the same underlying Lexile scale (Stenner, Burdick, Sanford, & Burdick, 2006). However, as with other readability formulas, the Lexile approach fails to take into account any linguistic aspects of text beyond word frequency and sentence length, or any nonlinguistic features (e.g., illustrations or graphics) that tend to be prevalent in books, especially informational texts, for children. Moreover, like other quantitative indices of text accessibility, predicting difficulty is a less stable enterprise at the low end of the difficulty scale—where small variations in word or sentence difficulty can yield large differences in the prediction measures for very short texts (MetaMetrics, 2007; Stenner et al., 2006).

Leveling Systems. Leveling systems, which involve collective professional judgment, have been developed to address the lack of attention to more qualitative aspects of difficulty (e.g., a sense that the conceptual load of a book is high or that its engagingness is low) in readability formulas. There are two types of leveling systems: those that rely on a set of criteria applied to the text, and those that compare any given text to anchor passages that have already been assigned levels (e.g., Chall et al., 1996). The most widely used leveling system (Fountas & Pinnell, 1996, 1999) consists of a set of criteria that human judges, usually teachers, apply in assigning levels to texts. These criteria take into account the complexity of the language as indexed by readability formulas, as well as more qualitative factors, such as (a) the degree of connection between the text and the illustrations, (b) the arrangement of text on the page, (c) the length, repetition, or predictability of the text, and (d) the complexity of the subject matter. Leveling systems can be useful for teachers when applied strategically to the selection of books for instruction; however, in contrast to readability formulas, they rely on qualitative judgments (Fry, 2002) and thus are subject to all of the biases involved in any aspect of human judgment. To date, guided reading levels have not been validated by empirical research that examines their potential to predict students' ability to comprehend texts, and there is some concern about the reliability of leveling systems, as well as their over-application in classrooms (Dzaldov & Peterson, 2005; Pitcher & Fang, 2007).

Multidimensional Approaches. Graesser, McNamara, and colleagues have been refining a multidimensional portfolio of linguistic indicators of text difficulty (e.g., Duran, Bellissens, Taylor, & McNamara, 2007). The multidimensional character of their work sets it apart from most other measures. Specifically, it allows examination of the compensatory nature of linguistic factors (i.e., if you have more of X, you can get by with less of Y. For example, while narratives tend to have low co-referential cohesion (e.g., words in Sentence 1 tend not to be repeated in Sentence 2)—a situation that normally promotes difficulties in comprehension—narratives tend to have high causal and temporal cohesion (plots tend to be strung out along a causal-temporal chain), allowing readers to build a coherent mental model in the face of low co-referential cohesion. Recently, the Coh-Metrix group (Graesser et al., 2011) conducted a Principal Components Analysis of a large body of K-12 texts (the TASA corpus) varying in difficulty according to conventional formulas. They determined that eight components accounted for 67% of the variance across texts. The eight are grouped into five theoretically meaningful indices.

1. **Narrativity** (genre) indexes storiness, with all its entailments of characters, events, and places. It is characterized by emphases on everyday language, familiar words, and common world knowledge.
2. **Syntactic simplicity** ranges from shorter, less syntactically complex, more familiar structures to longer, more complex structures with multiply embedded clauses.
3. **Word concreteness** reduces to something like the "imagability" of the average word in a sentence, and ranges from concrete to abstract.
4. **Referential cohesion** (textbase) assesses the degree of lexical/semantic overlap among sentences (how repetition and close lexical associations form explicit semantic threads).
5. **Deep cohesion** (situation model) is an index of the degree to which the causal, intentional, and temporal relationships among ideas are explicitly cued by connectives.

A rich body of research on accessibility notwithstanding, an even richer line of inquiry lies ahead of us, especially if we take seriously the challenge imposed by Common Core State Standards (2010) for a dramatic increase in the level of text complexity required of all students at every grade level. Two dilemmas stand out in this inquiry: (1) finding a valid and reliable way in which to scale difficulty at the lower levels—where readability formulas, including lexiles, yield woefully unstable indices of difficulty, and (2) figuring out how to scaffold this increase in text complexity for a population of students who experience enormous difficulty with the current level of text challenge.

Embedding Text Level Instruction Within Disciplinary Learning

As yet, empirical work on the instruction of disciplinary literacies is limited but growing. A body of work on content-area reading and writing does exist, but much of it is only peripherally linked to the idea of disciplinary participation; that is, it is more closely related to supporting students in reading content-area textbooks than to taking on the reading and reasoning practices of the disciplines. In addition, in recent years there has been a preponderance of work on cross-disciplinary integration of instruction that has focused on science and literacy, particularly at the elementary level. In the main, this work had focused more on using science instruction to support comprehension of and engagement with multi-genre texts (e.g., Guthrie & Ozgungor, 2002) and using literacy instruction to support science conceptual understandings and inquiry skills (e.g., Guzzetti & Bang, 2011) than involving students in authentic forms of disciplinary reading. Nevertheless, this work has demonstrated positive effects for the joining of science and literacy.

In particular, the Concept-Oriented Reading Instruction (CORI) project has yielded powerful evidence that connecting reading comprehension instruction to first-hand experiences in can engage students and support their reading growth. CORI researchers have demonstrated across a series of studies with elementary students that subject-matter connections and firsthand experiences results in more motivated and strategic literacy behavior and improves reading comprehension (Guthrie, Anderson, Alao, & Rinehart, 1999; Guthrie et al., 2006; Guthrie et al., 2004). In addition, Romance and Vitale (1992, 2001) have consistently demonstrated positive effects for the In-Depth Expanded Applications of Science (IDEAS) model, which replaces the time allocated for traditional literacy instruction with a 2-hour block of science instruction that includes attention to discussion, reading, concept mapping, and journal writing. Romance and Vitale have documented through a long program of research that IDEAS students across the elementary grades outpace students receiving their regular language arts and science programs on nationally normed standardized measures of science knowledge and reading comprehension.

Very recently, a few studies have taken a more disciplinary approach to reading and writing, with promising results. For example, De La Paz and Felton (2010) taught a historical reasoning strategy to 11th-grade students as a way of supporting their ability to write argumentative texts on historical topics. The researchers conceptualized reading and writing as closely linked, and part of the instructional intervention, therefore, involved reading historical texts using reading practices that reflect those of historians as described by Wineburg (1991). For example, students engaged in *sourcing* by using a set of "Consider the Author" questions, such as, "What do you know about the author? When was the document written? and How does the author's viewpoint have an effect on his argument?" (De La Paz & Felton, 2010, p. 182). Students who participated in this instruction produced historical writing that was better elaborated and more persuasive than students in a control group.

Greenleaf et al. (2011) examined the effects of the Reading Apprenticeship instructional framework on high school science students' reading and content understanding. The Reading Apprenticeship framework is intended to help teachers integrate disciplinary literacy practices into high school science teaching. While the approach is dedicated, in part, to helping student crack the code of content-area textbooks, it also focuses on the ways that scientists make sense of science texts and use them to inform investigations. The Reading Apprenticeship model is focused on the "metacognitive conversation," in which teachers model and discuss how to read science texts, why people read science texts in these ways, and the content of the texts. The students use complex science texts as they engage in the intellectual work of science inquiry. Greenleaf et al. found that students in the Reading Apprenticeship classrooms made greater gains on standardized tests in reading and biology than students in control classrooms.

At the elementary level, the Seeds of Science/Roots of Reading (Seeds/Roots) program has demonstrated positive effects for an integrated approach on students' reading, writing, and science understanding. The Seeds/Roots model positions literacy in support of students' involvement in science inquiry. Students read to deepen their involvement in investigations in ways that are similar to the ways that scientists read, that is, to inform their inquiry methods and situate their investigations within the work of other scientists (Cervetti & Barber, 2008). Across two studies with second-through fifth-grade students (Cervetti, Barber, Dorph, Pearson, & Goldschmidt, in press; Wang & Herman, 2005), the Seeds/Roots approach has shown advantages for treatment students on measures of science understanding, science vocabulary acquisition, and science writing, with a less consistent advantage for reading comprehension.

EXAMINING POLICY CONTEXTS FOR READING RESEARCH AND PRACTICE

As we asserted at the outset of this chapter, reading pedagogy has always been contested territory, with one version or another of a debate between progressive versus traditional, or child-centered versus curriculum-centered, or transmissionist versus constructivist perspectives (some would call them ideologies) playing out in virtually every decade of the past 100-plus years—7 score if one goes back Horace Mann and the Common School movement in Boston (Mathews, 1967). Whether it is labeled as analytic versus synthetic phonics (as it was in the 1890s), phonics versus look-say (as it was around the time of WWI), code versus meaning (as it was in the 1960s), skills versus whole language (as it was in the 1980s), or common standards for all versus the accommodation of individual differences (which is what it really has come down to in the NCLB era), protagonists line up on one side or another of the line in the sand, on the lookout for cracks in the curricular framework or flaws in the pedagogical tools of their adversaries. Both sides seek the moral high ground of doing what is right and best for children and their families.

Over the past decade the debate was intensified because the pedagogical argument became completely entangled with a parallel debate about the character of research required to validate the efficacy of instructional approaches (see Pearson, 2004, for an elaborate account of the issues and policy initiatives surrounding the research debate). The science card was first played at the federal level in the second term of the Clinton administration when the bill authorizing the Reading Excellence Act (REA), which allocated $240,000,000 for staff development to promote reading reform, required that both state and local applications for funding base their programs on research that meets scientifically rigorous standards. The *scientifically rigorous* phrase was a late entry; in all but the penultimate version of the bill, the phrase was *reliable, replicable research*, which had been interpreted as a code word for experimental research. In last days of the Clinton administration, the term scientifically rigorous research was morphed into scientifically based reading research, and defined as research that meets four standards. It must:

1. Employ systematic, empirical methods that draw on observation or experiment.
2. Involve rigorous data analyses that are adequate to test the stated hypotheses and justify the general conclusions drawn.
3. Rely on measurements or observational methods that provide valid data across evaluators and observers and across multiple measurements and observations.
4. Have been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review.

As of early 1999, “phonics bills” (bills mandating either the use of phonics materials or some sort of teacher training to acquaint teachers with knowledge of the English sound-symbol system and its use in teaching) had been passed or were pending in 36 states (e.g., U.S. Department of Education, 1999). The No Child Left Behind legislation of 2002 made this goal of “evidence-based practice” even more explicit, with the phrase *scientifically based reading research* appearing more than 110 times in the Reading First portion of this act reauthorizing Title I. The NCLB made this goal of evidence-based practice even more explicit, with the phrase *scientifically based reading research* appearing more than 110 times in the Reading First portion of this act reauthorizing Title I.

The problem in reading is that there was a natural confounding between the curricular position people took (whether they came down on highly structured approaches such as systematic early phonics or highly constructivist approaches such as literature-based reading or whole language) and their preferred epistemological and methodological approach to research. Constructivists tended to opt for ethnographic or other forms of qualitative research whereas those who favored systematic approaches tended toward experimental or at least quantitative approaches (see Pearson, 2004, or Pearson, 2007, for more elaborate accounts of the phenomenon). The net effect of this confounding has been, as it seems to be also in national politics in the early years of this decade of the teens, to close off the conversation between folks on either side of the line in the sand, with few opportunities for open debate and even fewer for rapprochement.

What has become difficult in this volatile context is to argue for the complementarity of methods and epistemologies in ways in which they exist in other fields in the basic sciences. Even the foremost research design methodology of the past half-century, Donald Campbell recognized this need, arguing in 1984 that qualitative and quantitative approaches must be complementary:

> To rule out plausible rival hypotheses we need situation-specific wisdom. The lack of this knowledge (whether it be called ethnography, program history, or gossip) makes us incompetent estimators of program impacts, turning out conclusions that are not only wrong, but are often wrong in socially destructive ways. . . . There is the mistaken belief that quantitative measures replace qualitative knowledge. Instead, qualitative knowing is absolutely essential as a prerequisite for quantification in any science. Without competence at the qualitative level, one’s computer printout is misleading or meaningless. (pp. 141–142)

We suspect that reading is not the only curricular landscape in which these tensions and these curricular/epistemological/methodological confounds are being enacted. In fact, based on a chapter that one of us wrote with a mathematics education colleague (Schoenfeld & Pearson, 2009), we know that mathematics is as contested as reading on these matters. So we hope that a rapprochement can occur on the research front across several areas of scholarship so that we can disentangle our curricular from our epistemological perspectives and methodological preferences. That would be a good step in determining on what we do and do not agree. And that might even lead to a situation in which we can see the virtue in complementary and converging approaches to examining and solving the vexing educational problems that plague all research scholars regardless of their preferences for understanding and conducting research (Shavelson & Towne, 2002).

REFERENCES

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Alexander, P. A. (2003). Profiling the developing reader: The interplay of knowledge, interest, and strategic processing. In C. M. Fairbanks, J. Worthy, B. Maloch, J. V. Hoffman, & D. L. Schallert (Eds.), *The 52nd yearbook of the national reading conference* (pp. 47–65). Oak Creek, WI: National Reading Conference.

Alexander, P. A. (2005). The path to competence: A lifespan developmental perspective on Reading. *Journal of Literacy Research, 37,* 413–436.

Alliance for Excellent Education. (2010). *Policy brief: The federal role in confronting the crisis in adolescent literacy*. Washington, DC: Alliance for Excellent Education. www.all4ed.org/files/FedRoleConfrontingAdolLit.pdf

Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.

Anderson, R. C., & Freebody, P. (1981). Vocabulary knowledge. In J. T. Guthrie (Ed.), *Comprehension and teaching: Research review* (pp. 71–117). Newark, DE: International Reading Association.

Anderson, R. C., & Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading. In P. D. Pearson, R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *Handbook of reading research.* White Plains, NY: Longman.

Anderson, R., Hiebert, E., Scott, J., & Wilkinson, I. (1984). *Becoming a nation of readers*. Champaign-Urbana, IL: Center for the Study of Reading.

Badian, N. A. (2001). Phonological and orthographic processing: Their roles in reading prediction. *Annals of Dyslexia, 51,* 179–202.

Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. In R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *Handbook of reading research* (pp. 353–394). New York, NY: Longman.

Baumann, J. F., & Bergeron, B. (1993). Story-map instruction using children's literature: Effects on first graders' comprehension of central narrative elements. *Journal of Reading Behavior, 25,* 407–437.

Baumann, J. F., & Graves, M. F. (2010). What is academic vocabulary? *Journal of Adolescent & Adult Literacy, 54,* 4–12.

Baumann, J. F., Bradley, B., Edwards, E. C., Font, G., & Hruby, G. (2000, December). *Teaching generalizable vocabulary-learning strategies: A critical review of the literature*. Paper presented at the annual meeting of the National Reading Conference, Scottsdale, AZ.

Baumann, J. F., Edwards, E. C., Boland, E. M., Olejnik, S., & Kame'enui, E. J. (2003). Vocabulary tricks: Effects of instruction in morphology and context on fifth-grade students' ability to derive and infer word meanings. *American Educational Research Journal, 40,* 447–494.

Beck, I. L., & McKeown, M. G. (2006). *Improving comprehension with questioning the author*. New York, NY: Scholastic.

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life: Robust vocabulary instruction*. New York, NY: Guilford Press.

Beck, I., & McKeown, M. (1990). Conditions of vocabulary acquisition. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 789–814). New York, NY: Longman.

Beck, I., Perfetti, C., & McKeown, M. (1982). The effects of long-term vocabulary instruction on lexical access and reading comprehension. *Journal of Educational Psychology, 74,* 506–521.

Berne, J. I., & Clark, K. F. (2008). Focusing literature discussion groups on comprehension strategies. *Reading Teacher, 62,* 74–79.

Best, R. M., Floyd, R. G., & McNamara, D. S. (2008). Differential competencies contributing to children's comprehension of narrative and expository texts. *Reading Psychology, 29,* 137–164.

Billings, L., & Fitzgerald, J. (2002). Dialogic discussion and the Paideia seminar. *American Educational Research Journal, 39*(4), 907–941.

Blaiklock, K. E. (2004). The importance of letter knowledge in the relationship between phonological awareness and reading. *Journal of Research in Reading, 27,* 36–57.

Block, C., & Pressley, M. (Eds.). (2002). *Comprehension instruction: Research-based best practices*. New York, NY: Guilford Press.

Bluestein, N. A. (2010). Unlocking text features for determining importance in expository text: A strategy for struggling readers. *Reading Teacher, 63,* 597–600.

Bond, G. L., & Dykstra, R. (1967). The cooperative research program in first-grade reading instruction. *Reading Research Quarterly, 32,* 348–427.

Bowers, P. N., & Kirby, J. R. (2010). Effects of morphological instruction on vocabulary acquisition. *Reading and Writing, 23,* 515–537.

Brown, A., Pressley, M., Van Meter, P., & Schuder, T. (l996). A quasi-experimental validation of transactional strategies instruction with low-achieving second grade readers. *Journal of Educational Psychology, 88,* 28–37.

Campbell, D. T. (1984). Can we be scientific in applied social science? In R. E. Conner, D. G. Altman, & C. Jackson (Eds.), *Evaluation studies: Review annual* (Vol. 9, pp. 85–97). Beverly Hills, CA: Sage.

Carlisle, J. F. (2007). Fostering morphological processing, vocabulary development, and reading comprehension. In R. K. Wagner, A. E. Muse, & K. R. Tannenbaum (Eds.), *Vocabulary acquisition: Implications for reading comprehension* (pp. 78–103). New York, NY: Guilford Press.

Carlisle, J. F., (2010). Effects of instruction in morphological awareness on literacy achievement: An integrative review. *Reading Research Quarterly, 45,* 464–487.

Carnegie Corporation of New York's Council on Advancing Adolescent Literacy. (2010). *Time to Act.* New York, NY: Carnegie.

Cervetti, G. N., & Barber, J. (2008). Text in hands-on science. In E. H. Hiebert & M. Sailors (Eds.), *Finding the right texts: What works for beginning and struggling readers* (pp. 89–108). New York, NY: Guilford Press.

Cervetti, G. N., Barber, J., Dorph, R., Pearson, P. D., & Goldschmidt, P. G. (In press). The impact of an integrated approach to science and literacy in elementary school classrooms. *Journal of Research in Science Teaching*.

Chall, J. S. (1967). *Learning to read: The great debate*. New York, NY: McGraw-Hill.

Chall, J. S., & Dale, E. (1995). *Readability revisited*. Cambridge, MA: Brookline.

Chall, J. S., Bissex, G. L., Conrad, S. S., & Harris-Sharples, S. (1996). *Qualitative assessment of text difficulty: A practical guide for teachers and writers*. Brookline, MA: Brookline Books.

Chinn, C. A., Anderson, R. C., & Waggoner, M. A. (2001). Patterns of discourse in two kinds of literature discussion. *Reading Research Quarterly, 36,* 378–411.

Clark, A. M., Anderson, R. C., Archodidou, A., Nguyen-Jahiel, K., Kuo, L.-J., & Kim, I. (2003). Collaborative reasoning: Expanding ways for children to talk and think in the classroom. *Educational Psychology Review, 15,* 181–198.

Coltheart, M. (2005). Modeling reading: The dual-route approach. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 6–23). Oxford, UK: Blackwell.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review, 108,* 204–256.

Common Core Standards. (2010). Common core state standards for English language arts. Washington, DC: Council of Chief State School Officers & National Governor's Association.

Cope, B., & Kalantzis, M. (Eds.). (1993). *The powers of literacy: A genre approach to teaching writing*. Pittsburgh, PA: University of Pittsburgh Press.

Cote, N., Goldman, S. R., & Saul, F. U. (1998). Student making sense of informational text: Relations between processing and representation. *Discourse Processexss, 25,* 1–53.

Coxhead, A. (2000). A new academic word list. *TESOL Quarterly, 34,* 213–238.

Cunningham, A. E., & Stanovich, K. E. (1997). Early reading acquisition and its relation to reading experience and ability 10 years later. *Developmental Psychology, 33,* 934–945.

Cunningham, A. E., Nathan, R. G., & Raher, K. S. (2011). Orthographic processing in models of word recognition. In M. L. Kamil, P. D. Pearson, E. B. Moje, & P. P. Afflerbach (Eds.), *Handbook of reading research* (Vol. 4, pp. 259–285). New York, NY: Routledge.

Davis, C. J. (2010). The spatial coding model of visual word identification. *Psychological Review, 117,* 713–758.

De La Paz, S., & Felton, M. K. (2010). Reading and writing from multiple source documents in history: Effects of strategy instruction with low to average high school writers. *Contemporary Educational Psychology, 35,* 174–192.

Dole, J., Duffy, G. G., Roehler, L. R., & Pearson, P. D. (1991). Moving from the old to the new: Research on reading comprehension instruction. *Review of Educational Research, 61,* 239–264.

Duke, N. D., Pearson, P. D., Strachan, S. L., & Billman, A. K. (2011). Essential elements of fostering and teaching reading comprehension. In S. J. Samuels & A. E. Farstrup (Eds.), *What research has to say about reading instruction* (4th ed., pp. 51–93). Newark, DE: International Reading Association.

Duke, N. K., & Bennett-Armistead, S. A. (2003). *Reading & writing informational text in the primary grades: Research-based practices*. New York, NY: Scholastic.

Duke, N. K., & Pearson, P. D. (2001). How can I help children improve their comprehension? In *Teaching every child to read: Frequently-asked questions*. Ann Arbor, MI: Center for the Improvement of Early Reading Achievement.

Duke, N., & Pearson, P. D. (2002). Effective practices for developing reading comprehension. In A. Farstrup & J. Samuels (Eds.), *What research has to say about reading instruction* (3rd ed., pp. 205–242). Newark, DE: International Reading Association.

Duran, N., Bellissens, C., Taylor, R., & McNamara, D. (2007). *Qualifying text difficulty with automated indices of cohesion and semantics*. Paper presented at the 25th Annual Meeting of the Cognitive Science Society, Austin, TX.

Durrell, D. D., & Murphy, H. A. (1953). The auditory discrimination factor in reading readiness and reading disability. *Education, 73,* 556–560.

Dzaldov, B. S., & Peterson, S. (2005). Book leveling and readers. *Reading Teacher, 59*(3), 222–229.

Eeds, M., & Wells, D. (1989). Grand conversations: An exploration of meaning construction in literature study groups. *Research in the Teaching of English, 23*(1), 4–29.

Ehri, L. (2005a). Learning to read words: Theory, findings and issues. *Scientific Studies of Reading, 9,* 167–188.

Ehri, L. (2005b). Development of sight word reading: Phases and findings. In M. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 135–154). Oxford, UK: Blackwell.

Ehri, L., Nunes, S., Willows, D., Schuster, B., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the national reading panel's meta-analysis. *Reading Research Quarterly, 36,* 250–287.

Englert, C. S., & Hiebert, E. H. (1984). Children's sensitivity to expository text structure. *Journal of Educational Psychology, 76,* 65–74.

Fang, Z., & Schleppegrell, M. J. (2010). Disciplinary literacies across content areas: Supporting secondary reading through functional language analysis. *Journal of Adolescent and Adult Literacy, 53,* 587–597.

Fisher, D., & Frey, N. (2008). *Word wise and content rich: Five essential steps to teaching academic vocabulary*. Portsmouth, NH: Heinemann.

Fisher, D., Frey, N., & Lapp, D. (2008). Shared readings: Modeling comprehension, vocabulary, text structures, and text features for older readers. *Reading Teacher, 61,* 548–556.

Fountas, I. C., & Pinnell, G. S. (1996). *Guided reading: Good first teaching for all children*. Portsmouth, NH: Heinemann.

Fountas, I. C., & Pinnell, G. S. (1999). *Matching books to readers: Using leveled books in guided reading, K-3*. Portsmouth, NH: Heinemann.

Fry, E. (1977). Fry's readability graph: Clarification, validity, and extension to level 17. *Journal of Reading, 21*(3), 242–252.

Fry, E. (2002). Readability versus leveling. *Reading Teacher, 56*(3), 286–291.

Gambrell, L. B., & Morrow, L. M. (1996). Creating motivating contexts for literacy learning. In L. Baker, P. Afflerbach, & D. Reinking (Eds.), *Developing engaged readers in home and school communities.* Mahwah, NJ: Erlbaum.

Gerrig, R. J., & O'Brien, E. J. (2005). The scope of memory-based processing. *Discourse Processes, 39,* 225–242.

Gerrig, R., & McKoon, G. (1998). The readiness is all: The functionality of memory-based text processing. *Discourse Processes, 26,* 67–86.

Goldenberg, C. (1993). Instructional conversations: Promoting comprehension through discussion. *Reading Teacher, 46,* 316–326.

Goldman, S. R. (1997). Learning from text: Reflections on the past and suggestions for the future. *Discourse Processes, 23,* 357–398.

Goldman, S. R., Graesser, A. C., & van den Broek, P. (1999). *Narrative comprehension, causality, and coherence: Essays in honor of Tom Trabasso*. Mahwah, NJ: Erlbaum.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7,* 6–10.

Graesser, A. C., Gernsbacher, M. A., & Goldman, S. R. (1997). Cognition. In T. A. van Dijk (Ed.), *Discourse: A multidisciplinary introduction* (pp. 292–319). London, UK: Sage.

Graesser, A. C., McNamara, D. S., & Kulikovich, J. M. (2011). Coh-Metrix: Providing multilevel analysis of text characteristics. *Educational Researcher, 40*(5), 223–234.

Graves, M. F. (2000). A vocabulary program to compliment and bolster a middle grade comprehension program. In B. M. Taylor, M. F. Graves, & P. van den Broek (Eds.), *Reading for meaning: Fostering comprehension in the middle grades* (pp. 116–135). Newark, DE: International Reading Association.

Great Books Foundation. (1987). *An introduction to shared inquiry*. Chicago, IL: Great Books Foundation.

Greenleaf, C. L., Litman, C., Handon, T. L., Rosen, R., Boscardin, C. K., Herman, J., . . . Jones, B. (2011). Integrating literacy and science in biology: Teaching and learning impacts of reading apprenticeship professional development. *American Educational Research Journal, 48,* 647–717.

Guthrie, J. T., & Ozgungor, S. (2002). Instructional contexts for reading engagement. In C. C. Block & M. Pressley (Eds.), *Comprehension instruction: Research-based best practices* (pp. 275–288). New York, NY: Guilford Press.

Guthrie, J. T., Anderson, E., Alao, S., & Rinehart, J. (1999). Influences of concept-oriented reading instruction on strategy use and conceptual learning from text. *Elementary School Journal, 99,* 343–366.

Guthrie, J. T., Wigfield, A., Barbosa, P., Perencevich, K. C., Taboada, A., David, M. H., . . . Tonks, S. (2004). Increasing reading comprehension and engagement through concept-oriented reading instruction. *Journal of Educational Psychology, 96,* 403–423.

Guthrie, J. T., Wigfield, A., Humenick, N. M., Perencevich, K. C., Taboada, A., & Barbosa, P. (2006). Influences of stimulating tasks on reading motivation and comprehension. *Journal of Educational Research, 99,* 232–245.

Guzzetti, B., & Bang, E. (2011). The influence of literacy-based science instruction on adolescents' interest, participation, and achievement in science. *Literacy Research and Instruction, 50,* 46–67.

Hagiliassis, N., Pratt, C., & Johnston, M. (2006). Orthographic and phonological processes inreading. *Reading and Writing, 19,* 235–263.

Halliday, M. A. K. (1961). Categories of the theory of grammar. Word 17. Reprinted in Bertil Malmberg (Ed.) 1972, *Readings in modern linguistics* (pp. 157–208). Stockholm, Sweden: Läromedelsförlagen-Mouton.

Harmon, J. M., Wood, K. D., & Hedrick, W. B. (2008). Vocabulary instruction in middle and secondary content classrooms: Understandings and direction from research. In A. E. Farstrup & S. J. Samuels (Eds.), *What research has to say about vocabulary instruction* (pp. 150–181). Newark, DE: International Reading Association.

Hart, B., & Risley, T. (1995). *Meaningful differences in everyday parenting and intellectual development in young American children*. Baltimore, MD: Brookes.

Heller, R., & Greenleaf, C. L. (2007). *Literacy instruction in the content areas: Getting to the core of middle and high school improvement*. Washington, DC: Alliance for Excellent Education.

Hiebert, E. H., & Lubliner, S. (2008). The nature, learning, and instruction of general academic vocabulary. In A. E. Farstrup & S. J. Samuels (Eds.), *What research has to say about vocabulary instruction* (pp. 106–129). Newark, DE: International Reading Association.

Hyland, K., & Tse, P. (2009). Academic lexis and disciplinary practice: Corpus evidence for specificity. *International Journal of English Studies, 9,* 111–130.

Johnson-Laird, P. N. (1983). *Mental models: Towards a cognitive science of language, inference, and consciousness*. Cambridge, UK: Cambridge University Press.

Kamil, M., Pearson, P. D., Moje, E., & Afflerbach, P. (Eds.). (2011). *Handbook of reading research* (Vol. 4). London, UK: Routledge.

Kelley, M. J., & Clausen-Grace, N. (2010). Guiding students through expository text with text feature walks. *Reading Teacher, 64,* 191–195.

Kendeou, P., Savage, R., & van den Broek, P. (2009). Revisiting the simple view of reading. *British Journal of Educational Psychology, 79,* 353–370.

Kendeou, P., van den Broek, P., White, M. J., & Lynch, J. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and code-related skills. *Journal of Educational Psychology, 4,* 765–778.

Kendeou, P., van den Broek, P., White, M., & Lynch, J. (2007). Preschool and early elementary comprehension: Skill development and strategy interventions. In D. S. McNamara (Ed.), *Reading comprehension strategies: Theories, interventions, and technologies* (pp. 27–45). Mahwah, NJ: Erlbaum.

Kintsch, W. (1988). The use of knowledge in discourse processing: A construction-integration model. *Psychological Review, 95,* 163–182.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge, UK: Cambridge University Press.

Kintsch, W. (2004). The construction-integration model of text comprehension and its implications for instruction. In R. B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading*. Newark, DE: International Reading Association.

Kintsch, W., & Kintsch, E. (2005). Comprehension. In S. G. Paris & S. A. Stahl (Eds.), *Children's reading comprehension and assessment* (pp. 71–92). Mahwah, NJ: CIERA.

Klare, G. (1984). Readability. In P. D. Pearson, R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *Handbook of reading research* (pp. 681–744). New York, NY: Longman.

Klinger, J. K., & Vaughn, S. (1999). Promoting reading comprehension, content learning, and English acquisition through collaborative strategic reading (CSR). *Reading Teacher, 52,* 738–747.

Kong, A., & Pearson, D. (2003). The road to participation: The construction of a literacy practice in a learning community of linguistically diverse learners. *Research in the Teaching of English, 38,* 85–124.

Lee, C. D., & Spratley, A. (2010). *Reading in the disciplines: The challenges of adolescent literacy*. New York, NY: Carnegie.

Leinhardt, G., & Young, K. M. (1996). Two texts, three readers: Distance and expertise in reading history. *Cognition and Instruction, 14,* 441–486.

Linderholm, T., Virtue, S., van den Broek, P., & Tzeng, Y. (2004). Fluctuations in the availability of information during reading: Capturing cognitive processes using the landscape model. *Discourse Processes, 37,* 165–186.

Lupker, S. J. (2005). Visual word recognition. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 39–60). Oxford, UK: Blackwell.

Marulis, L. M., & Neuman, S. B. (2010). The effects of vocabulary intervention on young children's word learning: A meta-analysis. *Review of Educational Research, 80,* 300–335.

Mathews, M. (1967). *Teaching to read, historically considered*. Chicago, IL: University of Chicago Press.

McKeown, M. G., Beck, I. L., & Blake, R. G. K. (2009). Rethinking comprehension instruction: Comparing strategies and content instructional approaches. *Reading Research Quarterly, 44,* 218–253.

McKeown, M. G., Beck, I. L., Omanson, R. C., & Pople, M. T. (1985). Some effects of the nature and frequency of vocabulary instruction on the knowledge and use of words. *Reading Research Quarterly, 20,* 522–535.

McNamara, T. P., Miller, D. L., & Bransford, J. D. (1991). Mental models and reading comprehension. In R. Barr, M. L. Kamil, P. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 490–511). White Plains, NY: Longman.

MetaMetrics (2007). *The Lexile framework for reading technical report*. Durham, NC: MetaMetrics.

Meyer, B. J. F., Brandt, D. M., & Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. *Reading Research Quarterly, 16,* 72–103.

Moje, E. B. (2008). Foregrounding the disciplines in secondary literacy teaching and learning: A call for change. *Journal of Adolescent and Adult Literacy, 52*(2), 96–107.

Moran, J., Ferdig, R. E., Pearson, P. D., Wardrop, J., & Blomeyer, R. L. (2008). Technology and reading performance in the middle-school grades: A meta-analysis with recommendations for policy and practice. *Journal of Literacy Research, 40,* 6–58.

Morrow, L. M. (1984). Reading stories to young children: Effects of story structure and traditional questioning strategies on comprehension. *Journal of Reading Behavior, 16,* 273–288.

Morrow, L. M. (1996). *Motivating reading and writing in diverse classrooms: Social and physical contexts in a literature-based program* (NCTE Research Report no. 28). Urbana, IL: National Council of Teachers of English.

Moss, B. (2005). Making a case and a place for effective content area literacy instruction in the elementary grades. *Reading Teacher, 59,* 46–55.

Murphy, P. K., Wilkinson, I. A. G., Soter, A. O., Hennessey, M. N., & Alexander, J. F. (2009). Examining the effects of classroom discussion on students' high-level comprehension of text: A meta-analysis. *Journal of Educational Psychology, 101,* 740–764.

Nagy, W. E. (1988). *Teaching vocabulary to improve reading comprehension*. Urbana, IL: NCTE.

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly, 19,* 304–330.

Nagy, W. E., Anderson, R. C., & Herman, P. A. (1987). Learning word meanings from context during normal reading. *American educational Research Journal, 24,* 237–270.

Nagy, W. E., Herman, P. A., & Anderson, R. C. (1985). Learning words from context. *Reading Research Quarterly, 20,* 233–253.

National Early Literacy Panel. (2008). *Developing early literacy: A report of the national early literacy panel*. Washington, DC: National Institute for Literacy. www.nifl.gov/earlychildhood/NELP/NELPreport.html

National Institute of Child Health and Human Development (NICHD). (2000). *Report of the national reading panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. (NIH Publication No. 00-4769). Washington, DC: U.S. Government Printing Office.

Oakhill, J., Cain, K., & Bryant, P. (2003). The dissociation of word reading and text comprehension: Evidence for component skills. *Language and Cognitive Processes, 18,* 443–468.

Osborne, J. (2010). Arguing to learn in science: The role of collaborative, critical discourse. *Science, 328,* 463–466.

Paivio, A. (1990). *Mental representations: A dual coding approach* (2nd ed.). New York, NY: Oxford University Press.

Palincsar, A. S., & Magnusson, S. J. (2001). The interplay of first-hand and text-based investigations to model and support the development of scientific knowledge and reasoning. In S. Carver & D. Klahr (Eds.), *Cognition and instruction: Twenty-five years of progress* (pp. 151–194). Mahwah, NJ: Erlbaum.

Palincsar, A., & Brown, A. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1,* 117–175.

Paribakht, T. S., & Wesche, M. B. (1997). Vocabulary enhancement activities and reading for meaning in second language vocabulary development. In J. Coady & T. Huckin (Eds.), *Second language vocabulary acquisition: A rationale for pedagogy* (pp. 174–200). New York, NY: Cambridge University Press.

Paris, S. G., Lipson, M. Y., & Wixson, K. K. (1994). Becoming a strategic reader. In R. B. Ruddell, M. R. Ruddell, & H. Singer (Eds.), *Theoretical models and processes of reading* (4th ed., pp. 788–810). Newark, DE: International Reading Association.

Pearson, P. D. (2004). The reading wars: The politics of reading research and policy–1988 through 2003. *Educational Policy, 18*(1), 216–252.

Pearson, P. D. (2007). An historical analysis of the impact of educational research on policy and practice: Reading as an illustrative case. In D. W. Rowe, R. T. Jiménez, D. L. Compton, D. K. Dickinson, Y. Kim, K. M. Leander, & V. J. Risko (Eds.), *56th yearbook of the national reading conference* (pp. 14–40). Oak Creek, WI: National Reading Conference.

Pearson, P. D. (2011). Toward the next generation of comprehension instruction: A Coda. In H. Daniels (Ed.), *Comprehension going forward: Where we are, what's next.* Portsmouth, NH: Heinemann.

Pearson, P. D., & Camparell, K. (1981). Comprehension of text structures. In J. Guthrie (Ed.), *Comprehension and teaching* (pp. 27–54). Newark, DE: International Reading Association.

Pearson, P. D., & Fielding, L. (1991). Comprehension instruction. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 815–860). White Plains, NY: Longman.

Pearson, P. D., & Hiebert, E. (2010). National reports in literacy: Building a scientific base for practice and policy. *Educational Researcher, 39*(4), 286–294.

Perfetti, C. A. (1999). Comprehending written language: A blueprint of the reader. In C. Brown & P. Hagoort (Eds.), *The neurocognition of language* (pp. 167–208). New York, NY: Oxford University Press.

Pitcher, B., & Fang, Z. (2007). Can we trust levelled texts? An examination of their reliability and quality from a linguistic perspective. *Literacy, 41*(1), 43–51.

Pressley, M. (2000). What should comprehension instruction be the instruction of? In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research* (Vol. 3, pp. 545–561). Mahwah NJ: Erlbaum.

Pressley, M., Brown, R., El-Dinary, P., & Afflerbach, P. (1995). The comprehension instruction that students need: Instruction fostering constructively responsive reading. *Learning Disabilities Research & Practice, 10,* 215–224.

Purcell-Gates, V., Duke, N. K., & Martineau, J. A. (2007). Learning to read and write genre-specific text: Roles of authentic experience and explicit teaching. *Reading Research Quarterly, 42,* 8–45.

Rand Reading Study Group. (2002). *Reading for understanding: Toward a research and development program in reading comprehension*. Santa Monica, CA: Rand.

Raphael, T. E., & McMahon, S. I. (1994). Book club: An alternative framework for reading instruction. *Reading Teacher, 48,* 102–116.

Raphael, T. E., Florio-Ruane, S., & George, M. (2001). *Book club plus: A conceptual framework to organize literacy instruction*. Ann Arbor, MI: Center for the Improvement of Early Reading Achievement Report. www.ciera.org/library/reports/inquiry-3/3-015/3-015.htm

Rapp, D. N., van den Broek, P., McMaster, K. L., Kendeou, P., & Espin, C. A. (2007). Higher-order comprehension processes in struggling readers: A perspective for research and intervention. *Scientific Studies of Reading, 11,* 289–312.

Reutzel, D. R., Smith, J. A., & Fawson, P. C. (2005). An evaluation of two approaches for teaching reading comprehension strategies in the primary years using science information texts. *Early Childhood Research Quarterly, 20,* 276–305.

Richgels, D. J., McGee, L. M., Lomax, R. G., & Sheard, C. (1987). Awareness of four text structures: Effects in recall of expository text. *Reading Research Quarterly, 22,* 177–196.

Romance, N. R., & Vitale, M. R. (1992). A curriculum strategy that expands time for in-depth elementary science instruction by using science-based reading strategies: Effects of a year-long study in grade four. *Journal of Research in Science Teaching, 29*(6), 545–554.

Romance, N. R., & Vitale, M. R. (2001). Implementing an in-depth expanded science model in elementary schools: Multi-year findings, research issues, and policy implications. *International Journal of Science Education, 23*(4), 272–304.

Rosenshine, B., & Meister, C. (1994). Reciprocal teaching: A review of research. *Review of Educational Research, 64,* 479–530.

Ruddell, R. B., & Unrau, N. J. (Eds.). (2004). *Theoretical models and processes of reading* (5th ed.). Newark, DE: International Reading Association.

Rueda, R., Goldenberg, C., & Gallimore, R. (1992). *Rating instructional conversations: A guide*. (Research Report EPR4.) National Center for Research on Cultural Diversity and Second Language Learning. www.ncela.gwu.edu/pubs/ncrcdsll/epr4.htm

Rumelhart, D. E., & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, & W. E. Montague (Eds.), *Schooling and the acquisition of knowledge*. Hillsdale, NJ: Erlbaum.

Sadoski, M., & Paivio, A. (2001). *Imagery and text: A dual coding theory of reading and writing*. Mahwah, NJ: Erlbaum.

Schleppegrell, M., & de Oliveira, L. C. (2006). An integrated language and content approach for history teachers. *Journal of English for Academic Purposes, 5,* 254–268.

Schoenfeld, A. H., & Pearson, P. D. (2009). The reading and math wars. In G. Sykes, B. Schneider, & D. Plank (Eds.), *Handbook of education policy research* (pp. 560–580). New York, NY: Routledge.

Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content-area literacy. *Harvard Educational Review, 78,* 40–59.

Shanahan, T., Callison, K., Carriere, C., Duke, N. K., Pearson, P. D., Schatschneider, C., & Torgesen, J. (2010). *Improving reading comprehension in kindergarten through 3rd grade: A practice guide* (NCEE 2010-4038). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. whatworks.ed.gov/publications/practiceguides

Share, D. L. (1995). Phonological recoding and self-teaching: Sine qua non of readingacquisition. *Cognition, 55,* 151–218.

Sharp, A. M. (1985). Philosophy for children and the development of ethical values. *Early Child Development and Care, 197,* 45–55.

Shavelson, R. J., & Towne, L. (Eds.). (2002). *Scientific research in education*. Washington, DC: National Academy Press.

Short, K. G., & Pierce, K. M. (1990). *Talking about books: Creating literature communities*. Portsmouth, NH: Heinemann.

Smith, D., Stenner, A. J., Horabin, I., & Smith, M. (1989). *The Lexile scale in theory and practice: Final report*. Washington, DC: MetaMetrics.

Snow, C. E. (2010). Academic language and the challenge of reading for learning about science. *Science, 328,* 450–452.

Snow, C. E., Lawrence, J. F., & White, C. (2009). Generating knowledge of academic language among urban middle school students. *Journal of Research on Educational Effectiveness, 2,* 325–344.

Snow, C., Burns, M., & Griffin, P. (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.

Snowling, M., & Hulme, C. (Eds). (2005). *The science of reading: A handbook*. Oxford, UK: Blackwell.

Soter, A. O., Wilkinson, I. A. G., Murphy, P. K., Rudge, L., Reninger, K., & Edwards, M. (2008). What the discourse tells us: Talk and indicators of high-level comprehension. *International Journal Educational Research, 47,* 372–391.

Spache, G. (1953). A new readability formula for primary-grade reading materials. *Elementary School Journal, 53* (7), 410–413.

Stahl, S. A., & Fairbanks, M. M. (1986). The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research, 56,* 72–110.

Stahl, S. A., & Stahl, K. A. (2004). Word wizards all!: Teaching word meanings in preschool and primary education. In J. F. Baumann & E. J. Kame'enui (Eds.), *Vocabulary instruction*. New York, NY: Guilford Press.

Stenner, A. J., Burdick, H., Sanford, E. E., & Burdick, D. S. (2006). How accurate are Lexile text measures? *Journal of Applied Measurement, 7,* 307–322.

Swanson, H. L., Trainin, G., Necoechea, D. M., & Hammill, D. D. (2003). Rapid naming, phonological awareness, and reading: A meta-analysis of the correlation evidence. *Review of Educational Research, 73,* 407–440.

Taylor, B. M., & Samuels, S. J. (1983). Children's use of text structure in the recall of expository material. *American Educational Research Journal, 20,* 517–528.

Taylor, B. M., Pearson, P. D., Peterson, D. S., & Rodriguez, M. C. (2003). Reading growth in high-poverty classrooms: The influence of teacher practices that encourage cognitive engagement in literacy learning. *Elementary School Journal, 104,* 3–28.

Tharp, R. G., & Gallimore, R. (1991). *The instructional conversation: Teaching and learning in social activity*. Washington, DC: Center for Applied Linguistics.

Thurlow, R. & van den Broek, P. (1997). Automaticity and inference generation during reading. *Reading and Writing Quarterly, 13,* 165–181.

Tierney, R. J., & Cunningham, J. W. (1984). In P. D. Pearson, R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *Handbook of reading research* (pp. 609–655). New York, NY: Longman.

Trabasso, T., Secco, T., & van den Broek, P. (1985). Causal cohesion and story cohesion. In H. Mandl, N. L. Stein, & T. Trabasso (Eds.), *Learning and comprehension of text* (pp. 83–111). Hillsdale, NJ: Erlbaum.

Trabasso, T., Secco, T., & van den Broek, P. W. (1984). Causal cohesion and story coherence. In H. Mandl, N. L. Stein & T. Trabasso (Eds.), *Learning and comprehension of text* (pp. 83–111). Hillsdale, NJ: Erlbaum.

U.S. Department of Education. (1999). *Reading excellence act state competitive grant program: Non-regulatory guidance for state applicants-March 9, 1999*. www2.ed.gov/inits/FY99/REAguidance/sectionB.html

van den Broek, P. (1994). Comprehension and memory of narrative texts: Inferences and coherence. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 539–588). New York, NY: Academic Press.

van den Broek, P. (2010). Using texts in science education: Cognitive processes and knowledge representation. *Science, 328,* 453–456.

van den Broek, P. (April 23, 2010). Using texts in science education: Cognitive processes and knowledge representation. *Science, 328,* 453–456.

van den Broek, P. W. (1990). The Causal Inference Maker: Towards a process model of inference generation in text comprehension. In D. A. Balota, G. B. Flores d'Arcais, & K. Rayner (Eds.), *Comprehension processes in reading* (pp. 423–446). Hillsdale, NJ: Erlbaum.

van den Broek, P., Bohn-Gettler, C., Kendeou, P., Carlson, S., & White, M. J. (2011). When a reader meets a text: The role of standards of coherence in reading comprehension. In M. T. McCrudden, J. P. Magliano, & G. Schraw (Eds.), *Text relevance and learning from text* (pp. 123–140). Greenwich, CT: Information Age Publishing.

van den Broek, P., Fletcher, C. R., & Risden, K. (1993). Investigations of inferential processes in reading: A theoretical and methodological integration. *Discourse Processes, 16,* 169–180.

van den Broek, P., Lorch, R. F. Jr., Linderholm, T., & Gustafson, M. (2001). The effects of readers' goals on inference generation and memory for texts. *Memory & Cognition, 29,* 1081–1087.

van den Broek, P., White, M. J., Kendeou, P., & Carlson, S. (2009). Reading between the lines: Developmental and individual differences in cognitive processes in reading comprehension. In R. Wagner, C. Schatschneider, & C. Phythian-Sence (Eds.), *Beyond Decoding: The Behavioral and Biological Foundations of Reading Comprehension* (pp.107–123). New York, NY: Guilford Press.

van den Broek, P., Young, M., Tzeng, Y., & Linderholm, T. (1998/2004). The landscape model of reading: Inferences and the on-line construction of a memory representation. In H. van Oostendorp & S. R. Goldman (Eds.), *The construction of mental representations during reading* (pp. 71–98). Mahwah, NJ: Erlbaum. (Reprinted in R. B. Ruddell & N. J. Unrau [Eds.], *Theoretical models and processes of reading* [pp. 1244–1269]. Newark, NJ: International Reading Association.)

Van Orden, G. C., & Kloos, H. (2005). The science of reading: A handbook. In M. S. Snowling & C. Hulme (Eds.), *The question of phonology and reading* (pp. 61, 78). Oxford, UK: Blackwell.

Vitale, M. R., & Romance, N. R. (2007). A knowledge-based framework for unifying content-area reading comprehension and reading comprehension strategies. In D. S. McNamara (Ed.), *Reading comprehension strategies: Theories, interventions, and technologies* (pp. 73–106). Mahwah, NJ: Erlbaum.

Vygotsky, L. (1934/1987). *Thinking and speech*. New York, NY: Plenum Press.

Wang, J., & Herman, J. (2005). Evaluation of seeds of science/roots of reading project: Shoreline science and terrarium investigations. Los Angeles, CA: CRESST, UCLA. http://scienceandliteracy.org/research/efficacy_studies

Whitehurst, G., & Lonigan, C. (1998). *Child development* and emergent literacy. Child Development, *69,* 848–872.

Wilkinson, I. A. G., & Son, E. H. (2011). A dialogic turn in research on learning and teaching to comprehend. In M. L. Kamil, P. D. Pearson, E. Moje, & P. Afflerbach (Eds.), *Handbook of reading research* (Vol. 4, pp. 359–387). New York, NY: Routledge.

Williams, J. P., Hall, K. M., Lauer, K. D., Stafford, K. B., De Sisto, L. A., & deCani, J. S. (2005). Expository text comprehension in the primary grade classroom. *Journal of Educational Psychology, 97,* 538–550.

Williams, J. P., Nubla-Kung, A. M., Pollini, S., Stafford, K. B., Garcia, A., & Snyder, A. E. (2007). Teaching cause-effect text structure through social studies content to at-risk second graders. *Journal of Learning Disabilities, 40,* 111–120.

Wineburg, S. S. (1991). On the reading of historical texts: Notes on the breach between school and the academy. *American Educational Research Journal, 28,* 495–519.

CHAPTER 13

Mathematical Learning

RICHARD LEHRER AND RICHARD LESH

MATHEMATICAL LEARNING

Does beauty have structure? How does a hinge work? What happens if zero divides a number? Do the symmetries of a triangle and the set of integers under addition share any structure in common? How many distinct patterns of wallpaper design are possible? What are nature's numbers? How do nurses determine drug dosages (e.g., Pozzi, Noss, & Hoyles, 1998) or entomologists develop quantities to characterize relations among termites (e.g., Hall, Stevens, & Torralba, 2002)? What forms of mathematical activity are found in automotive production (Smith, 2002) or in the work of geologists (Liben, Kastens, & Christensen, 2011)? Questions like these suggest the enormous imaginative scope and practical reach of mathematics and demonstrate that mathematicians are jugglers not of numbers, but of concepts (e.g., Stewart, 1975). Mathematical practice spans a universe of human endeavor, ranging from art and craft to engineering design, and its products extend over much of recorded history (Davis & Hersh, 1981). Despite this long history of mathematics, systematic study of mathematical learning occupies only a brief slice in time. Nevertheless, research in mathematics education and in the psychology of mathematical learning continues to grow, so any review of this research is necessarily incomplete and highly selective.

Our choices for this review stem from a genetic view of knowledge (Piaget, 1970), a "commitment that the structures, forms, and possibly the content of knowledge is determined in major respects by its developmental history" (diSessa, 1995, p. 23). Rather than considering the developmental history of concepts, such as number, or of age groups, such as children in the primary grades, we have chosen to emphasize themes of epistemic practice (Knorr Cetina, 1999)—the forms of collective activity that lead to the generation and revision of mathematical knowledge. We describe potential origins and developmental landscapes of these mathematical modes of thought or "ways of thinking" (Harel, 2008, p. 269). As a list of epistemic practices would be open-ended, we focus on a few characterized by wide scope that span multiple realms of mathematical endeavor.

The first of these is *argument*, which has roots in everyday discourse and dialogue about contested claims but can be refined and extended to mathematical forms of argument, such as conjecture, refutation, and proof. Arguments explain the structure of mathematical systems and, accordingly, probe not the products of mathematical activity, but their grounds. For example, one could assert that the sum of specific quantities, such as 9 and 7, is 16. In contrast, claims about mathematical structure might lead to a conjecture that this sum is but an instance of a theorem that the sum of two odd whole numbers is an even whole number. A warrant for this generalization could be a series of cases, but a mathematical argument focuses instead on the structure of the number system, a form of argument called proof. Proofs are explanations that appeal to the structure of a mathematical system. They are arguments in the sense that they are intended to resolve competing claims, and of course, their adequacy can be and often is contested (Lakatos, 1976).

Although everyday activity provides resources for the development of arguments, these resources must be cultivated and orchestrated if they are to become mathematical arguments. Since our last review, there has been an upsurge in the quality and quantity of research devoted toward situating mathematical argument in K–12 classrooms that are explicitly designed to orient students toward forms of mathematical explanation, including studies of students' definitions, conjectures, refutations, generalizations and proofs. Of these, we focus on generalization and proof as emblematic of this strand of research. Emphasis on these forms of mathematical practice in classrooms has inspired renewed attention to the nature of teacher knowledge, sometimes called mathematics knowledge for teaching or MKT (Hill, Schilling, & Ball, 2004). MKT is necessary, if not entirely sufficient, to generate and sustain teaching practices that create opportunities for students to engage in these forms of argument. And, there has been a trend to more closely analyze teaching practices that sustain students' dispositions toward engaging and sustaining these forms of argument. Therefore, we have revised our attention to the genetic roots of mathematical argument to encompass some of the research that investigates how teaching practices position students to argue mathematically.

The second mode of knowledge generation, *inscription and visualization*, originates in written expression, such as words and drawings, and extends to the development of specialized forms of writing mathematics, especially systems of notation (Roth & McGinn, 1998; Rotman, 1988). Increasingly, these systems of notation are dynamic and this computational capacity opens new vistas for visualizing mathematical objects and relations. Inscription and visualization co-occur with argument in a reflexive relation. Claims about the properties of a mathematical system often derive from the creation and manipulation of these inscriptions and visualizations.

Modeling, the third mode of knowledge generation, relies on propensities to understand situations by creating analogies (Giere, 1992; Hesse, 1962; Hestenes, 1992). These informal capacities are made explicit in models that specify relations between different mathematical systems or between mathematical and natural or designed systems. Modeling relies on forms of argument and on related inscriptions and visualizations, but it also underscores the need to develop accounts of mathematical learning at the boundaries of pure and applied mathematical inquiry (e.g., Wilensky, 2003). Since our last review, there also has been an upsurge of research related to both modeling and visualization. New technologies have radically increased the importance of both. For example, even in daily newspapers like *USA Today*, sections ranging from sports to business are filled with graphs, tables, diagrams, and other representations used to describe trends, patterns, and functions of situations that impact the everyday lives of ordinary people. The ability to create, analyze, anticipate, and assess the models that underlie these descriptions has emerged as an important type of literacy in the 21st century. By forging links to fields ranging from engineering to modern incarnations of traditional topics in mathematics or science education, both modeling and visualization require a more comprehensive and integrated view of teaching and learning mathematics. These advances render obsolete conceptions of "pure" mathematics, in which mathematics is regarded as a subject that must be mastered before phenomena in the world can be described mathematically. Again reflecting our orientation to development, we explore the possibilities for student participation in the generation and revision of models as opportunities for mathematical expression and innovation. Modeling supports expressive kinds of mathematical thinking, in which the products that students produce include novel artifacts, tools, or mathematical systems.

The chapter begins with examination of the nature of mathematical argument. It traces a path between everyday forms of argument and those that are widely recognized as distinctly mathematical. We focus on epistemology, the grounds for knowing, and skills of argument, rather than on the more familiar heuristics and processes of mathematical reasoning. (For tours of these heuristics and forms of reasoning, see Haverty, Koedinger, Klahr, & Alibali, 2000; Leinhardt & Schwarz, 1997; Schoenfeld, 1992). We suggest that the developmental roots of mathematical argument reside in the structure of narrative and pretend play, but also describe how these roots must be nurtured to promote epistemic appreciation of proof and the value of generalization. As previously noted, nurturing the disposition to engage in mathematical argument requires incubating epistemic cultures appropriate to nourish these forms of learning. Hence, in the second section, we consider the design of learning environments, including the role of the teacher in orchestrating elements of these designed environments to engage students in constructing and revising mathematical arguments.

Third, we turn to the role that inscriptions (e.g., markings on a medium such as paper) and more dynamic digital notations play in the growth and development of mathematical ideas. We aim to illuminate the developmental relationship between informal scratches on paper and more modern, sophisticated kinds of symbol systems employed in mathematical practice, including digital technologies. Inscription and mathematical thinking co-originate (Rotman, 1993), so that mathematics emerges as a distinct form of literacy, much as writing distinguishes itself from speech. During the past decade, the field of inquiry has expanded to include more careful analysis of the roles played by dynamic notations in the growth of mathematical thinking and learning (e.g., research featured in *Technology, Knowledge and Learning*). These computational notations generate new possibilities for visualization. Accordingly, we include representative studies of computational visualization in geometry and statistics and trust that our relatively cursory treatment will inspire interested readers to delve more deeply into the potential of dynamic notations.

Fourth, we consider research in *modeling* that spans K–12 and beyond. As previously indicated, modeling melds forms of argument and inscription-visualization, yet positions students to employ mathematics expressively. Since our last review, modeling has been the subject of international investigation and is often the site of efforts to relate mathematics to engineering and science educations. Hence, modeling marks a turn toward developing a more comprehensive view of teaching and learning mathematics, one that may soon make obsolete chapters (like this one) devoted solely to mathematical learning. Mathematics developed historically within a wide range of human endeavor. The turn toward modeling restores some of this range to the mathematical experiences of students.

A final comment about the studies selected for this review: they reflect cognitive (e.g., Anderson & Schunn, 2000) and sociocultural, including situated (Greeno, 1998) perspectives on learning. Studies of cognitive development typically shed light on cognitive processes of individuals. In contrast, sociocultural perspectives typically underscore thinking as mediated activity, emphasizing how being a member of a society constitutes thinking at all levels of analysis (e.g., Forman, 2003; Mead, 1910; Nunes, 1999; Wertsch, 1998). Individuals are inherently social, even if it is useful to distinguish between collective and individual forms of analysis. Both forms of analysis are indispensable and in fact, these perspectives are interwoven in their influence on learners, regardless of researchers' proclivities to consider them as distinct enterprises. Although these theories may consider different time scales from an extrinsic perspective, both operate intrinsically in the field of vision of individual learners or even collectives of learners at particular points of time. Consider, for example, the idea of learning to construct a geometric proof. On the one hand, a cognitive analysis characterizes the kinds of skills required to develop a proof and describes how these skills must be orchestrated to construct a proof (e.g., Koedinger & Anderson, 1990). These descriptions seem indispensable to instructional design (Anderson & Schunn). On the other hand, the need for proof is cultural, arising from an epistemology that values proof as explanation (Harel & Sowder, 1998; Hersh, 1993). Herbst and Balacheff (2009) further demonstrate that students' proof performances in classrooms are shaped by multiple levels of cultural influence, ranging from images of proof derived from the discipline, classroom norms or expectations about teaching and learning, and the interactions among individuals that constitute the classroom culture. For example, the structure of two-column proof so widely practiced in schools originated from efforts in the late 1800s to format close justification of every proposition advanced during the activity of proving (Herbst, 2002). Needless to say, the majority of teachers and students are unaware of the intentions of these 19th-century originators, but nonetheless operate in a space governed by this reification of mathematical reasoning. The sociocultural perspective clarifies that this form of mathematical thinking (i.e., proof), and every other form as well, relies on historic developments of cultural tools and trends, so that the challenge for the design of a mathematics education is to select and amplify these cultural tools and trends to inculcate a classroom culture that values proof. How might one design classrooms where proofs explain, and where these explanations can be valued and transformed in the course of everyday classroom activity? What would students then learn? In the sections that follow, we attempt to strike a balance between these two levels of explanation, because both supply important accounts of mathematical learning.

THE GROWTH OF ARGUMENT

Arguments explain the properties of mathematical structures. Proof is often taken as emblematic of mathematical argument, because it both explains and provides grounds for certainty that are hard to match or even imagine in other disciplines, such as history or the natural sciences. Everyday folk psychology often associates proof with drudgery, but for mathematicians proof is a form of discovery (e.g., de Villiers, 1998) and even "epiphany" (e.g., Benson, 1999). Proofs encompass several aims, including persuasion, certification of previous results, explanation, and exploration (Auslander, 2008; Detlefsen, 2008). Yet proof is a culmination of these aims, not their origin, so in this section we trace the ontogeny of forms of reasoning that ground proof and proof-like forms of explanation. Our approach is necessarily speculative because there is no compelling study of the long-term development of an epistemic appreciation for mathematical argument. Moreover, our representative of mathematical argument, proof, is often misunderstood as a series of conventional procedures for arriving at the empirically obvious, rather than as a form of explanation (Schoenfeld, 1988). International comparisons of students (e.g., Healy & Hoyles, 2000) confirm this impression, and apparently many teachers hold similar views (Knuth, 2002; Martin & Harel, 1989). Nonetheless, several lines of research suggest fruitful avenues for generating an epistemology of mathematical argument that is better aligned with mathematical practice and more likely to engage students with progenitors from which this epistemology can be developed. Accordingly, in the sections that follow, we suggest that mathematical argument evolves from everyday argument and represents an epistemic refinement of everyday discursive reasoning. This evolution is grounded in the structure of everyday conversation, sustained by the growth and development of an appreciation of pretense and possibility, and honed through participation in communities of mathematical inquiry that promote generalization and explanation. During the past decade, much has been learned about how classroom communities can be designed to sustain forms of argument based on producing mathematical generalization and justifications of these generalizations.

Conversational Structure as a Resource for Developing Mathematical Argument

Contested claims are commonplace and there is no more prevalent arena for resolving differing perspectives than conversation. Although we may more readily recall debates and other specialized formats as sparring grounds, everyday conversation also provides many opportunities for developing "substantial" arguments (Toulmin, 1958). By *substantial,* Toulmin referred to arguments that expand and modify claims and propositions but that lead to conclusions not contained in the premises, unlike those of formal logic. For example, Ochs, Taylor, Rudolph, and Smith (1992) examined family conversations that included young children (e.g., 4 to 6 years of age) talking about mundane events, such as recall of "the time when" (e.g., mistaking chili peppers for pickles), or of a contemporary episode in family life. Ochs et al. (1992) found that dinnertime narratives engender many of the elements of sound argument in a manner that parallels scientific debate. First, narratives implicate a problematic event, a tension in need of resolution, so that narratives often embody some form of contest, or at least, contrast. Second, the problematic event invites causal explanation during the course of the conversation. Moreover, these causal explanations may be challenged by co-narrators or listeners, thus establishing a tacit anticipation of the need to ground claims. Challenges in everyday conversations can range from matters of fact such as disputing what a character said, to matters of ideology, such as disputing the intentions of one of the characters in the account. Conarrators often respond to these challenges by redrafting narratives to provide alternative explanations or to better align outcomes with a family's worldview. Ochs et al. argued that theories and stories may be generated, critiqued, and revised in ways that share many counterparts with scientific discourses (also see Hall, 1999; Warren, Ballanger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001, regarding continuities between everyday and scientific discourses).

Studies like those of Ochs et al. (1992) are typical of much of the work in conversation analysis, which suggests that the structure of everyday talk in many settings is an important resource for creating meaning (Drew & Heritage, 1992). For example, Rips (1998; Rips, Brem, & Bailenson, 1999) noted that everyday conversationalists typically make claims, ask for justification of others' claims, contest claims, and contest the justifications offered in defense of a claim. The arrangement of these conversational moves gives argumentation its characteristic shape. Judgments of the informal arguments so crafted depend not only on the logical structure of the argument, but also on possible alternative states of the claims and warrants suggested. Rips and Marcus (1976) further suggested that reasoning about such suppositions, or possible states, requires bracketing uncertain states in memory in order to segregate hypothetical states from what is currently believed to be true. In the next section we review evidence about the origins and constraints on this cognitive capacity to reason about the hypothetical.

Reasoning About Hypothetical States

Reasoning about hypothetical states involves developing the capacity to reason about relations among possible states of the world, to treat aspects of them as if they were in the world, to objectify possibilities, and to coordinate these states of possibility (e.g., conjectures, potential causal chains) with evidence. And, during these activities, both theory and evidence are socially sanctioned, and thus cannot be properly regarded apart from participation in communities that encourage, support, and otherwise value these forms of reasoning. Our approach departs, therefore, from developmental accounts oriented toward the structure of logic (e.g., Inhelder & Piaget, 1958; Steffe & Olive, 2009), although these accounts of logical development also acknowledge the role of formative experiences. We focus first on the development of representational competence in everyday contexts, especially its origins in pretend play, and then on corresponding competencies in conditional reasoning. We then turn from everyday competence to dispositions to construct sound arguments that coordinate theory and evidence and, in mathematics, to prove. Because these dispositions do not seem to arise as readily as the competencies that underlie them, we conclude with an examination of the characteristics of classroom practices that support the development of generalization and grounds for certainty.

Development of (mental) representational competencies. Mathematical argument often requires reasoning about possible states of affairs, sometimes even in light of counterfactual evidence. In many ways, this capacity is supported by everyday conversational structure. Reasoning about possibility also requires mental representation of possible states. This representational capacity generally emerges towards the end of children's second year and is evident in their pretend play. For example, Leslie (1987) clarified the representational demands of pretending that a banana is a telephone, while knowing very well that the banana remains a banana, after all. He suggested that pretense is founded in meta-representational capacity to constitute (and distinguish) a secondary representation of one's primary representation of objects and events. Meta-representation expands dramatically during the preschool years. Consider, for example, DeLoache's (1987, 1989, 1995) work on children's understanding of scale models of space. DeLoache encouraged preschoolers to observe while she hid small objects in a scale model of a living room. Then she brought them into an identically furnished full-scale room and asked them to find similar objects in the analogous locations. DeLoache observed a dramatic increase in representational mapping between the model and the world between 2.5 and 3 years of age. Younger children did not seem to appreciate that an object hidden under the couch in the model was a clue to the location of its correspondent in the room, even though they readily described these correspondences verbally. In contrast, slightly older children could readily employ the model as a representation, rather than as a world unto itself, suggesting that they could sustain a clear distinction between representation and world.

Gentner's (Gentner & Loewenstein, 2002; Gentner & Toupin, 1986) work on analogy also focuses on early developing capacities to represent relational structures so that one set of relations can stand in for another. For example, Kotovsky and Gentner (1996) presented triads of patterns to children ranging from 4 to 8 years of age. One of the patterns was relationally similar to an initially presented pattern (e.g., small circle, large circle, small circle matched to small square, large square, small square), and the third was not (e.g., large square, small square, small square). Although the 4-year-olds responded at chance levels, 6- and 8-year-olds preferred relational matches. These findings are consistent with a relational shift from early reliance on object-matching similarity to later capacity and preference for reasoning relationally (Gentner, 1983). This kind of relational capacity undergirds conceptual metaphors important to mathematics, like those between collections of objects and sets in arithmetic, and forms the basis for the construction of mathematical objects (Lakoff & Nunez, 2000). We revisit this theme in the section on modeling. Moreover, Sfard (2000) notes that although discourse about everyday events and objects is a kind of first language game (in Wittgenstein's sense), the playing field in mathematics is virtual, so that mathematical discourse is often about objects that have no counterpart in the world. Hence, the capacity for analogical reasoning and for reasoning about possible states is critical to mathematical learning.

Knitting possibilities: Counterfactual reasoning. Research on the emergence of representational competence illuminates the impressive cognitive achievement of creating and deploying representational structures of actual, potential, and pretend states of the world. However, it is yet another cognitive milestone to act on these representations to establish relations among them, a capacity that relies on reasoning about relations among these hypothetical states. Children's ability to engage in such hypothetical reasoning is often discounted, perhaps because the seminal work of Inhelder and Piaget (1958) stressed children's, and even adults', difficulties with the (mental) structures of logical entailment. However, these difficulties do not rule out the possibility that children may engage in forms of mental logic that provide resources for dealing with possible worlds, even though they may fall short of an appreciation of the interconnectedness of mental operators dictated by formal logic. For the current purpose of considering routes to mathematical argument, we focus on findings related to counterfactual reasoning—reasoning about possible states that run counter to knowledge or perception, yet are considered for the sake of the argument (Levi, 1996; Roese, 1997). Counterfactual reasoning is at the heart of deductive modes of thought that do not rely exclusively on empirical knowledge. Seeds of counterfactual reasoning are first manifested in children's capacity to coordinate separate representations of true and false states of affairs in pretend play (Amsel & Smalley, 2001). In one of the first studies of young children's hypothetical reasoning, Hawkins, Pea, Glick, and Scribner (1984) asked preschool children (4 and 5 years) to respond to syllogistic problems with three different types of initial premises: (1) congruent with children's empirical experience (e.g.,"Bears have big teeth"); (2) incongruent with children's empirical experience (e.g., "Everything that can fly has wheels"); and (3) a fantasy statement outside of their experience (e.g., "Every banga is purple"). Children responded to questions posed in the syllogistic form of modus ponens ("Pogs wear blue boots. Tom is a pog. Does Tom wear blue boots?"). They usually answered the congruent problems correctly and the incongruent problems incorrectly. Furthermore, children's responses to incongruent problems were consistent with their experience, rather than the premises of the problem. This *empirical bias* was a consistent and strong trend. However, unexpectedly, when the fantasy expressions were presented first, children reasoned from premises, even if these premises contradicted their experiences. This finding suggested that the fantasy form supported children in orienting to the logical structure of the argument, rather than being distracted by its content. Subsequently, Dias and Harris (1988, 1990) presented young children (4-, 5-, and 6-year-olds) with syllogisms, some counterfactual, such as, "All cats bark. Rex is a cat. Does Rex bark?" When they were cued to treat statements as make-believe, or when they were encouraged to imagine the states depicted in the premises, children at all ages tended to reason from the premises as stated, rather than from their knowledge of the world. Scott, Baron-Cohen, and Leslie (1999) found similar advantages of pretense and imagination with another group of 5-year-old children as well as with older children who had learning disabilities.

Harris and Leevers (2001) suggested that extraordinary conditions of pretense need *not* be invoked to find evidence of counterfactual reasoning. When preschool children were simply prompted to think about the content of counterfactual premises or, as they put it, to adopt an analytic perspective, they could do so. Further research on children's understandings of the entailments of conditional clauses suggests that at or around age 8, many children interpret these clauses biconditionally. That is, they treat the relationship symmetrically (Kuhn, 1977; Taplin, Staudenmayer, & Taddonio, 1974), rather than treating the first clause as a sufficient but not necessary condition for the consequent (e.g., treating "if anthrax, then bacteria" as symmetric). However, Jorgensen and Falmagne (1992) assessed 6-year-old children's understanding of entailment in story formats and found that this form of narrative support produced comprehension of entailment more like that typically shown by adults. O'Brien, Dias, Roazzi, and Braine (1998) suggested that the conflicting conclusions like these about conditional reasoning can be traced to the model of material implication (if P, then Q) based on formal logic. O'Brien and colleagues argued that it may be a mistake to evaluate conditional reasoning via the truth table of formal logic (especially the requirement that a conditional is true whenever its antecedent is false). This perspective, they think, obscures the role of conditionals in ordinary reasoning. They proposed instead that a set of logic inference schemas governs conditional reasoning. Collectively, these schemas rely on supposing that the antecedent is true and then generating the truth of the consequent. They found that second- and fifth-grade children in both the United States and Brazil could judge the entailments of the premises of a variety of conditionals (e.g., P or Q, Not-P or Not-Q) in ways consistent with these schemas, rather than strict material implication. Even preschool children judged a series of counterfactual events, for example, those that would follow from a character pretending to be a dog, as consistent with a story. An interesting result was that they also excluded events that were suppositionally inconsistent with the story, for example, the same character talking on the phone even though those events were presumably more consistent with their experience (i.e., people, not dogs, use phones). Collectively, these studies of hypothetical reasoning point to an early developing competence for representing and comparing possible and actual states of the world, as well as for comparing possible states with other possible states. Moreover, these comparisons can be reasoned about in ways that generate sound deductions that share much, although do not overlap completely, with formal logic. These impressive competencies apparently arise from the early development of representational competence, especially in pretend play (Amsel & Smalley, 2001), as well as the structure of everyday conversation. However, despite these displays of early competence, other work suggests that the skills of argument are not well honed at any age and are especially underdeveloped in early childhood.

The Skills of Argument

Kuhn (1991) suggested that an argument demands not only generating possibilities but also comparing and evaluating them. These skills of argument demand a clear separation between beliefs and evidence, as well as development of the means for establishing systematic relations between them (Kuhn, 1989). Kuhn (2001) viewed this development as one of *disposition* to use competencies like those noted, a development related to people's epistemologies: "What they take it to mean to know something" (Kuhn, 2001, p. 1). In studies with adults and adolescents (ninth graders) who attempted to develop sound arguments about the causes of unemployment, school failure, and criminal recidivism, most of those interviewed did not seem aware of the inherent uncertainty of their arguments in these ill-structured domains (Kuhn, 1991, 1992). Only 16% of participants generated evidence that would shed light on their theories, and only about one-third were consistently able to generate counterarguments to their positions. Kuhn, Amsel, and O'Loughlin (1988) found similar trends with people ranging in age from childhood (age 8) to adulthood who also attempted to generate theories about everyday topics like the role of diet in catching colds. Participants again had difficulty generating and evaluating evidence and considering counterarguments. Apparently, these difficulties are not confined to comparatively ill-structured problems. For example, in a study of the generality and specificity of expertise in scientific reasoning, Schunn and Anderson (1999) found that nearly a third of college undergraduate participants never supported their conjectures about a scientific theory with any mention of empirical evidence. Kuhn (2001) further suggested that arguments constructed in contexts ranging from science to social justice tend to overemphasize explanation and cause at the expense of evidence and, more important, that it is difficult for people at all ages to understand the complementary epistemic virtues of each (understanding versus truth).

Everyday Conceptions of Proof Are Empirical

The difficulties that most people have in developing epistemic appreciations of fundamental components of formal or scientific argument suggest that it might be difficult to learn how to comprehend and produce more specialized epistemic forms of mathematical argument, such as proof. A number of studies confirm this anticipation. Edwards (1999) invited 10 first-year high school students to generate convincing arguments about the truth of simple statements in arithmetic, such as, "Even x odd makes even." The modal justification was, "I tried it and it works" (Edwards, p. 494). When pressed for further justification, students resorted to additional examples. In a study of 60 high school students who were invited to generate and test conjectures about kites, Koedinger (1998) noted that "almost all students seemed satisfied to stop after making one or a few conjectures from the example(s) they had drawn" (p. 327). Healy and Hoyles (2000) examined the responses of approximately 2,500 secondary students participating in a proof-oriented curriculum and again noted pronounced trends for empirical justification. Knuth, Choppin, and Bieda (2009) examined the types of arguments generated by 400 middle school students, all participating in a mathematics reform curriculum, who attempted to verify the universality of structures such as: "Mei discovered a number trick. She takes a number and multiplies it by 5, and then she adds 12. She then subtracts the starting number and divides the result by 4. She notices the answer she gets is always 3 more than the number she started with." Knuth et al. (2009) found that approximately 80% of the students across grades 6 to 8 relied on examples for conviction, and examples were the modal form of explanation across five other statements presented to these students.

Martin and Harel (1989) examined the judgments of a sample of preservice elementary teachers enrolled in a second-year university mathematics course. More than half judged a single example as providing a valid proof. Many did not accept a single counter-case as invalidating a generalization, perhaps because they thought of mathematical generalization as a variation of the generalizations typical of category prototypes (e.g., Rosch, 1973). Outcomes like these are not confined to prospective teachers or to the students they will one day teach: Segal (2000) noted that 40% of entry-level university mathematics students also judged examples as valid proofs.

What makes proof hard? One source of difficulty seems to be instruction at the secondary level that emphasizes formalisms, such as two-column proofs, at the expense of explanation (Coe & Ruthven, 1994; Schoenfeld, 1988). Herbst (2002) suggested that classroom practices like two-column proofs often bind students and their instructors in a pedagogical paradox because the inscription into columns embodies two contradictory demands. The format scripts students' responses so that a valid proof is generated. Yet this emphasis on form obscures the rationale for the choice of the proposition to be proved: Why is it important to prove the proposition so carefully? What does the proof explain? Hoyles (1997; Healy & Hoyles, 2000) added that curricula are often organized in ways that de-emphasize deductive reasoning and scatter the elements of proof across the school year (Schoenfeld, 1988, 1994). In their analysis of university students' conceptions of proof, Harel and Sowder (1998) found that many students seem to embrace ritual and symbolic forms that share surface characteristics with the symbolism of deductive logic. For example, many students, even those entering university, appear to confuse demonstration and proof and therefore value a single case as definitive.

Although many studies emphasize challenges inherent in the logic of proof, such as the appeal to universality as responses to particular problems and settings, others examine proof as a social practice, one in which acceptability of proof is grounded in the norms of a community (e.g., Hanna, 1991, 1995). These social perspectives on proof emphasize that it is a form of rationality governed by artifacts and conventions about evidence, rigor, and plausibility that interact with logic (Lakatos, 1976; Thurston, 1995). Segal (2000) pointed out that conviction, one's personal belief, and validity, the acceptance of this belief by others, may not always be consistent. She found that for first-year mathematics students, these aspects of proof were often decoupled. This finding accords well with Hanna's (1990) distinction between proofs that prove and those that explain, a distinction reminiscent of Kuhn's (2001) contrast between explanation and evidence.

Chazan (1993) explored the proof conceptions of 17 high school students from geometry classes that emphasized empirical investigation as well as deductive proof. Students had many opportunities during instruction to compare deduction and induction over examples. One component of instruction emphasized that measurement of examples may suffer from accuracy and precision limitations of measurement devices (for example, the sum of the angles of triangles drawn on paper). A second component of instruction highlighted the risks of specific examples because one does not know if one's example is special or general. Nevertheless, students did not readily appreciate the virtues of proof. One objection offered by students was that examples constituted a kind of proof by evidence, if one was careful to generate a wide range of them. Other students believed that deductive proofs did not provide safety from counterexamples, perhaps because proof was usually constructed within a particular diagram. Harel (1998) suggested that many of these difficulties can be traced to fundamental epistemic distinctions that arose during the history of mathematics. In his view, students' understanding of proof is often akin to that of the Greeks, who regarded axioms as corresponding to ideal states of the world (see also Kline, 1980). Hence, mathematical objects determine axioms, but in a more modern view, objects are determined by axioms. Moreover, in modern mathematics, axioms yield a structure that may be realized in different forms. Hence, students' efforts to prove are governed by epistemologies that have little in common with those of the mathematicians teaching them, a difficulty that is both cultural and cognitive. Of course, the cultural-epistemic obstacles to proof are not intended to downplay cognitive skills that students might need to generate sound proofs (e.g., Koedinger, 1998). Nevertheless, it is difficult to conceive why students would acquire the skills of proof if they do not see its epistemic point. Moreover, even when students are not conceiving of proof empirically, nonetheless it remains a challenging form of argument. For example, Weber (2010) examined 28 mathematics majors' perceptions of conviction, validity, and proof. As expected, these students firmly rejected empirical example as sufficient warrant for proof. Nevertheless, the majority also accepted flawed deductive arguments as valid proofs, suggesting that even for this specialized population, processing the argument advanced by the proof was not trivial.

Reprise of Pathways of Mathematical Argument

The literature paints a somewhat paradoxical portrait of the development of mathematical argument, especially the epistemology of proof. On the one hand, mathematical argument relies on everyday competencies, like those involved in resolving contested claims in conversation and those underlying the generation and management of relations among possible states of the world. On the other hand, mathematical argument invokes a disposition to separate conjectures from evidence and to establish rigorous relations between them—propensities that appear problematic for people at any age. Moreover, the emphasis on structure and certainty in mathematics appears to demand an epistemological shift away from exemplifications in the world toward structures governed by axioms that may not correspond directly to any personal experience, except perhaps by metaphoric extension (e.g., Lakoff & Nunez, 1997, 2000). To these cognitive burdens we can also safely assume that the practices from which this specialized form of argument springs are hidden, both from students and even (within subfields of mathematics) from mathematicians themselves (e.g., Thurstone, 1995). Yet, contemporary research prescribes a synthesis where the everyday and the mathematical can converse, so that mathematical argument can be supported by—yet be differentiated from—everyday reasoning. In the next sections, we explore these possibilities.

SUPPORTING THE DEVELOPMENT OF MATHEMATICAL ARGUMENT IN DESIGNED LEARNING ENVIRONMENTS

As the previous summary illustrates, research generally paints a dim portrait of students' capabilities for harnessing native resources to create sound mathematical arguments, especially those involved in generalization and proof. Nonetheless, an emerging body of research suggests a conversational pathway toward developing these forms of mathematical argument in classrooms. The premise is that classroom discourse can be formatted and orchestrated in ways that make the grounds of mathematical argument visible and explicit even to young children, partly because everyday discourse offers a structure for negotiating and making explicit contested claims and potential resolutions (e.g., Wells, 1999), and partly because classrooms can be designed so that "norms" (e.g., Barker & Wright, 1954; Garfinkel & Sacks, 1970; Yackel & Cobb, 1996) of participant interaction can include mathematically fruitful ideas, such as the value of generalization. A norm is a sociological construct developed to account for regularities in conversational exchanges among participants in a community that function to allow members to anticipate the course of interactions with others. From this perspective, rather than treating acceptance or disagreement about a claim solely as internal states of mind, these contests are externalized as discursive activities (van Eemeren et al., 1996). A related claim is that classrooms can be designed as venues for initiating students in the "register" (Halliday, 1978; Pimm, 1987) or "Discourse" (Gee, 1997, in press) of a discipline like mathematics. Dialogue, then, is a potential foundation for supporting argument, and studies of student learning across disciplines appear to provide evidence that sound arguments can be developed by explicitly supporting disciplinarily relevant dialogic interaction. In the next section, we review studies of dialogue and argument outside of the field of mathematics education because these studies suggest design principles for supporting argument in any discipline.

Principles of Design for Disciplinary Dialogue

Engle and Conant (2002) traced the course of student dialogue about species identity in two fifth-grade classrooms within a community-of-learners (Brown & Campione, 1996) science classroom. They found that "productive disciplinary engagement" was fostered by forms of teaching that conferred students with authority to address important problems but that also simultaneously encouraged accountability to disciplinary values. The latter form of accountability held students responsible for making justifications consistent with ways that knowledge about species is typically generated in life sciences. Similarly, Kuhn, Shaw, and Felton (1997) asked adolescents and young adults to create arguments for or against capital punishment. Compared to a control condition in which students were simply asked twice to explain their views, a group engaged in dyadic interactions (one session per week for 5 weeks) was much more likely to create arguments that addressed the desirability of capital punishment within a framework of alternatives. Students in this dyadic group also were more likely to develop a personal stance about their arguments, articulating their beliefs within the constellation of the positions developed in dialogue. The development of argument in this group was not primarily related to hearing about the positions of others, but rather to the need to articulate one's own position, which apparently instigated voicing new forms of argument. Moreover, those participating in the dyadic conversations elaborated and made more explicit the criteria by which one might judge the desirability of capital punishment.

Other research has been more explicit about structuring dialogue. For example, Herrenkohl and Guerra (1998) assigned small working teams of fourth-grade students to distinct discourse roles, such as comprehension monitor (responsible for articulating the positions of other students as the group investigated problems of force and motion). In this study two equivalent matched groups of students with the same teacher were compared. One group enacted the roles only in a small group setting, and the other, during both small group and whole class conversation. Although students in both groups engaged in forms of reasoning valued by the discipline, there was generally a higher incidence of student-initiated challenge, monitoring of changing theories and procedures, and coordination of theory and evidence in the classroom where these roles were enacted in both settings. Moreover, the teacher had to do most of the work of coordinating theory and evidence for the group that did not exercise the roles across settings. Again with fourth-grade students, Anderson, Chinn, Chang, Waggoner, and Yi (1997) examined the logical integrity of the arguments developed by fourth-grade children who participated in discussions about dilemmas faced by characters in a story. The discussions were regulated by norms of turn taking (students spoke one at a time and avoided interrupting each other), attentive listening, and respectful challenge. The teacher's role was to facilitate student interaction but not to evaluate contributions. Anderson et al. (1997) analyzed the microstructure of the resulting classroom talk. They found that children's arguments generally conformed to modus ponens (if p, then q) when unstated but shared premises of children were taken into account. This context of shared understandings, generated from collective experiences and everyday knowledge, resolved referential ambiguities and thus constituted a kind of sound, conversational logic. However, "only a handful of children were consistently sensitive to the possibility of backing arguments with appeals to general principles" (Anderson et al., 1997, p. 162). Yet, such an emphasis on the general is an important epistemic component of argument in mathematics, which suggests that mathematics classrooms may need to be more than incubators of dialogue and sites of conversational exchange to accomplish what Engle and Conant (2002) termed productive disciplinary engagement. Accordingly, we turn next to considering some of the studies that have examined ways of formatting dialogue to support mathematical argument.

Dialogic Formats for Supporting Mathematical Argument

Ball and Bass (2003) point out that to do mathematics, classrooms must be organized in ways that allow students to "learn to offer, justify, and critically evaluate mathematical claims" (p. 37). This, in turn, requires that the teacher and students establish a collective conversational space and a mathematical language that allows such a public space to develop and grow. Henningsen and Stein (1997) found that student engagement in classroom mathematics was associated with a sustained press for justification, explanations, or meaning through teacher questioning, comments, and feedback. Tracking classroom conversation during a year in one third-grade classroom, Hufferd-Ackles, Fuson, and Sherin (2004) established that a productive conversational community entailed a transition from the teacher as the leading authority and author of talk to forms of exchange featuring co-authorship of mathematical ideas and products. For example, initially the teacher evaluated student responses with respect to their correctness, but (considerably) later in the year, the same teacher employed students' responses as legitimate objects for collaborative investigation, with attendant increases in students' appropriation of responsibility for learning consistent with Engle and Conant's (2002) principles for productive disciplinary engagement. Hufferd-Ackles et al. characterize these forms of dialogue as constituting what they term a math-talk community. However, Spillane and Zeuli (1999) noted that despite endorsing mathematics reform, many teachers have difficulty orienting student-centered conversation in the classroom toward significant mathematical principles and concepts. For example, Nathan and Knuth (2003) tracked an experienced middle school mathematics teacher for 2 years as she worked to reorient classroom conversations to encourage increased student participation. Although student-led discussion increased markedly, it often did so at the expense of disciplinary forms of argument. Nonetheless, a growing body of evidence addresses critical components of the work involved in restructuring classrooms as forums for public exchange and mathematical development.

Norms. One line of study follows a sociological tradition of the analysis of norms. To promote mathematical reasoning with primary-grade children, Cobb and his colleagues examined the role of conversational norms explicitly attuned to mathematical justification, such as those governing what counted as an acceptable mathematical explanation (e.g., Cobb, Wood, Yackel, & McNeal, 1992; Cobb, Yackel, & Wood, 1988; Yackel & Cobb, 1996). These studies showed that installing norms specifically related to mathematics contributed to a classroom microculture where children were oriented toward the search for mathematical structure and for sufficient grounds to warrant claims. The need to contribute to this kind of collective activity prompted students to talk about, for example, how one child's strategy was similar to or different from those described by classmates, a step toward mathematical generalization (McClain & Cobb, 2001). Wood (1999) traced how a second-grade teacher apprenticed students to the discourse of mathematical disagreement, differentiating this kind of disagreement from everyday, personal contest. She cautioned that although a casual observer might presume the installation of norms about mathematical difference is effortless, in fact, it took extensive work by the teacher to ensure that norms like these were widely adopted.

Hershkowitz and Schwarz (1999) tracked the arguments made by sixth-grade students in small group and collective discussions of solution strategies. They observed that pedagogy in the sixth-grade class they studied was oriented toward "purifying" students' invented strategies by suppressing surface-level differences among the variants proposed. The resulting distillation focused student attention on meaningful differences in mathematical structures. Here again the negotiation of a norm, in this case, what counted as a mathematical difference, inspired the growth of mathematical thinking.

Krummerheuer (1998) suggests that mathematical norms operate by formatting mathematical conversation in ways that afford more ready recognition of similarities in the nature of the argument supporting particular claims. For example, Krummerheuer (1995) documented how two second-grade boys initially disagreed about the similarity of their solution methods to the problem of 8×4, but later found that although one subtracted four from a previous result (9×4) and another subtracted eight from a previous result (10×4), they were really talking about the "same way." This conversational realization initiated discovery of what made them the same—a quality that was staged again by the norm of what counted as different.

Although studies of mathematical norms are typically conducted by means of participant observation, Herbst and his colleagues employed another sociological tradition—the breaching experiment. In these studies, small groups of teachers viewed animations of classroom dialogues in which norms presumed to govern teaching and learning of proof were violated. What was of interest was whether participants noticed the violation, and if so, how they attempted to repair the breach. By means of these breaching experiments, Herbst and his colleagues established that much of students' reasoning about proof is governed by norms about proof activity in classrooms. For example, high school students expect that teachers will sanction the theorems that will serve as resources for later attempts to construct proofs (Herbst, Nachlieli, & Chazan, 2011). Students also expect clear indications in the statement of a task or problem situation that they are responsible for constructing a proof (Herbst & Brach, 2006).

Mathematics knowledge for teaching. Although installing mathematical norms clearly contributes to productive mathematical conversations, a second line of study indicates that staging mathematical norms and related actions to orchestrate productive classroom discourse requires distinct forms of knowledge, "mathematics knowledge for teaching," MKT (Hill et al., 2004). MKT is not identical to knowledge of the discipline, although it is supported by disciplinary knowledge (e.g., Ma, 1999). MKT encompasses elements such as understanding the mathematical basis of unconventional solutions that students may invent, the types of errors that students are likely to make, and the kinds of examples or problems that are likely to help students develop better appreciation of a particular idea or process. Teachers' levels of MKT predict student achievement (Hill, Rowan, & Ball, 2005). Hill et al. (2008) found that teachers characterized by higher levels of MKT relative to their peers conducted lessons that were rich in mathematical conceptions, marked by judicious choice of examples, and characterized by whole-class dialogues in which teachers capitalized on the seeds of mathematical ideas expressed by students. In contrast, (teachers') mathematical errors during the course of teaching were highly but negatively related to levels of MKT. However, the relationship between MKT and student learning is apt to be moderated by other factors, as acknowledged by Hill et al. (2008). These moderators include the nature of curricular resources and the discursive practices that we referred to previously. For example, Shechtman, Roschelle, Haertel, and Knudsen (2010) found that measures of MKT did not consistently predict student learning about rate, proportionality, and linear function, perhaps because this form of knowledge may exhibit a threshold effect, meaning that other factors dominate once a teacher has achieved "enough" knowledge about likely patterns of student thinking to identify the mathematically productive seeds that students express during the course of conversation.

Other forms of knowledge that appear consequential for student learning of mathematics include what teachers infer, or "notice" about student thinking. This line of research is informed by Goodwin's (1994) construct of professional vision, which attends to how members of a profession develop perceptual frameworks that serve to render complex phenomena visible and tractable. For example, Jacobs, Lamb, and Philipp (2010) compared what different populations of K–3 teachers noticed about a video clip of first- and second-grade students solving a whole number word problem (a 9-minute condensation of a 40-minute lesson). Participants also viewed written student work involving base-tem understanding. The populations sampled were intended to represent a potential spectrum of developing professional vision, ranging from prospective to experienced teachers who engaged in at least 4 years of professional development centered around analysis of children's thinking and who also supported other teachers' learning. Analytic categories included (a) what participants selected or highlighted about the video episode, (b) their interpretations of these selections, and (c) their proposals, and rationales for problems to pose in light of the first two components of professional vision. As expected, increasing levels of experience were associated with increased attention to the nature of the strategies children employed to solve problems, including recognizing and describing the mathematically important aspects of a strategy. Increasing levels of experience were also associated with interpretative frameworks wherein different student strategies could be related and associated with different states of emerging arithmetic knowledge, consistent with the accounts of children's development featured in the professional development. Prospective teachers and teachers with limited teaching experience (2 years or less) were less able to notice these important mathematical seeds, so the mere act of teaching did not appear to ineluctably lead to better noticing of mathematical activity in the classroom. Only those teachers who had engaged in analysis and response to children's thinking for a prolonged period of time crafted instructional responses tailored to particular children. In a related vein, Choppin (2011) observed five teachers implementing challenging, standards-based mathematics curriculum (CMP) for 3 years their classrooms. Two of the teachers, who attended closely to the details of student thinking as manifested by student talk and written work, successfully adapted the curriculum materials to provide students with greater opportunities to make sense of important mathematical ideas. The other three primarily evaluated student talk and writing as either right or wrong. They also adapted the curriculum, but in ways that reduced the mathematical complexity of the task, a commonplace response to ambitious curricula (Stein, Grover, & Henningsen, 1996). Choppin (2011) noted that the pair of teachers who productively adapted the curriculum had many opportunities to analyze student thinking collaboratively and to consider the implications of their analysis for crafting sequences of instructional tasks. Similarly, Sherin and her colleagues (e.g., Sherin, 2007; Sherin & van Es, 2009), describe growth in professional vision among teachers who participated in video clubs focused on relations between teaching actions and student thinking. This group of studies suggests that helping teachers develop these forms of knowledge is liable to demand sustained and prolonged professional development.

Orchestrating and sustaining conversation. Because dialogues are often extended and dynamically adaptive, another research focus has been on how teachers manage conversational spaces in ways that foster mathematical learning. O'Connor and Michaels (1996) explain that teacher orchestration of classroom conversations "provides a site for aligning students with each other and with the content of the academic work while simultaneously socializing them into particular ways of speaking and thinking" (p. 65). The conversational mechanisms by which teachers orchestrate mathematically productive arguments include "revoicing" student utterances—that is, teachers repeat, expand, rephrase, or animate these parts of conversation in ways that increase their scope or precision or that juxtapose temporally discrete claims for consideration (O'Connor & Michaels, 1993, 1996). For example, a student may explain how she solved a perimeter problem by saying that she counted all around the hexagonal shape. In response, her teacher might rephrase the utterance by substituting "perimeter" for "all around." In this instance, the teacher substitutes a mathematical term, "perimeter," for a more familiar but imprecise construction, "all around," thereby transforming the student's everyday utterance into mathematical reference (Forman, Larreamendy-Joerns, Stein, & Brown, 1998).

Revoicing encompasses goals than more complex than substituting mathematical vocabulary for everyday words or even expanding the range of a mathematical concept. Some revoicing appears to be aimed at communicating respect for ideas and at the larger epistemic agenda of helping students identify critical aspects of mathematical activity, such as the need to "know for sure," or the notion that a case can be a window to a more general pattern (e.g., Strom, Kemeny, Lehrer, & Forman, 2001). Jacobson and Lehrer (2000) examined differences in how second-grade teachers revoiced children's comments about geometric transformations as they designed a quilt. Some of the teachers revoiced student comments in ways that invited conjectures about the causes of observed patterns or that drew attention to how a case illustrated a general concept of transformation. In those classes, students' learning about transformational geometry exceeded that of their counterparts who participated in classes where teachers merely paraphrased or repeated student utterances. Hence, forms of revoicing were consequential for student learning. Chapin, O'Connor, and Anderson (2003) propose other "talk moves" that complement revoicing, such as asking a student to restate the position and claim of another student. Case studies of students conducted by these researchers again indicate strong associations between particular forms of talk and learning mathematics. Staples (2007) conducted a longitudinal study of a high school teacher's attempts to position students to exchange ideas and work together to solve problems, Staples found that the teacher supported student contributions not only by employing the expansions suggested by Chapin and colleagues (2003), but also by establishing and monitoring a common ground for conversational exchange, using simple conversational moves such as repetition and more complex ones involving coordination that maintained continuity of an argument over time. Staples also suggested that teacher knowledge of prototypical benchmarks of student learning and of what Ball (1993) termed the mathematical horizon sustained these classroom dialogues. For example, during an instructional exchange, the teacher assessed student knowledge formatively and steered the conversation in light of her knowledge of prospective trajectories of learning.

Finally, conversational exchange is consequential not only for student learning in the sense of knowledge of particular mathematical operations, relations, and ideas, but also for developing productive dispositions (National Research Council, 2001) to engage in mathematical activity. For example, Boaler (2002a, 2002b; Boaler & Staples, 2008) contrasted student learning and dispositions toward mathematics in two kinds of instruction: dialogically oriented reform teaching and more traditional, expository instruction. Students participating in the dialogically centered approaches performed better on assessments indicating mathematical reasoning, tended to persist longer when encountering difficult and even challenging problems, and reported greater affinity for mathematics. Tracing the classroom participation of four middle school students during the course of a school year, Gresalfi (2009) noted that shifts in student disposition arose not from the general contours of conversation, but rather from the accumulation of moment-to-moment opportunities for students to relate a new idea to previously learned ideas, to explain why a particular idea or solution was reasonable, and to work collaboratively to make sense of an emerging idea or procedure.

Generalization and Proof Emerge in Supportive Dialogic Frames

In the previous section, we described some of the hallmarks of classroom cultures that appear to incubate productive and prolonged engagement in cycles of mathematically fruitful activity. These classroom cultures introduce ideas and problems that are apt to generate variability in the nature of claims, solutions, and the like, with dialogue as the site for establishing and grounding these competing claims and then managing cycles of refutation, extension via generalization, and perhaps proof to resolve these competing claims. Creation of classroom cultures characterized by these forms of activity requires skillful teaching, which in turn relies on installing norms, reading and interpreting states of student knowledge, and responding productively in the moment, with an eye toward fruitful pathways of mathematical learning. Instructional conversations that support the development of productive dispositions appear to require shared responsibilities for teaching and learning, although this is surely a matter of degree, not kind, in any pedagogy. In this section, we investigate how participating in instructional cultures like these influences student learning of proof—a previously intractable challenge for mathematical learning. Our investigation is confined to studies of student learning about one or more components of proof, where we are reasonably assured that the classroom culture was richly dialogic.

We begin with studies that describe how students first come to appreciate the need for generalization and proof. Lampert (2001; Lampert, Rittenhouse, & Crumbaugh, 1996) describes a student's claim that 13.3 is one fourth of 55. At the same time, other students claimed, and the class accepted, that 27.5 is one half of 55. A member of the class refuted the initial claim, pointing out that $13.3 + 13.3 = 26.6$ (not 26.5), with the tacit premise that one fourth and one fourth is one half. Lampert (2001) noted that the logical form of this refutation generated an orientation toward student authority and justification, so that the teacher was not the sole or even chief authority on mathematical truth. Ball (1993) and Ball and Bass (2000) documented a similar process with third-grade students who worked from contested claims to commonly accepted knowledge by processes of conjecturing, generating cases, and "confronting the very nature and challenge of mathematical proof" (Ball & Bass, 2000, p. 196). For example, a pair of students conjectured that the sum of two odd numbers was even, generating many instances to support their claim, as might be expected from the more commonplace attribution of proof by example. Yet, they remained dissatisfied with their own argument, because, as one of them said, "You can't prove that Betsy's conjecture always works. Because um, there's, um like, numbers go on and on forever and that means odd numbers and even numbers go on forever, so you couldn't prove that all of them aren't" (Ball & Bass, 2000, p. 196). These concerns about the limits of cases were echoed by other primary-grade students participating in a class oriented toward a reform vision of teaching and learning geometry (Lehrer, Jacobson et al., 1998). Second-grade students designing quilts noted that they were reasonably certain that application of either a flip, slide, turn, or a composition thereof to an asymmetric "core square" could result in the construction of a symmetric design from an asymmetric unit. However, they concluded that failure to generate a counter-case was insufficient grounds for accepting the conjecture. Several claimed, "We'd have to test all the core squares in the world that are asymmetric," and added, moreover, that even such an exhaustive search would not account for the possibility that someone could generate novel and untested instances of asymmetry: "People are probably making some right now" (Lehrer et al., 1998, p. 183). Collectively, these studies demonstrate that, like the mathematics majors described by Weber (2010), the children in these classrooms rejected examples as sufficient warrant for generalization.

Ellis (2011) conducted a 15-day teaching experiment with six middle school students and subsequently described seven forms of conversational exchange that promoted generalization. These ranged from public posting of a generalization to encouraging generalization. Although Ellis contributed to the emphasis on generalization in her role as the students' teacher, nonetheless there was clear evidence that students appropriated these forms of support, demonstrating that these forms of interaction and collaboration are within the grasp of students even in the absence of their teacher. Student appropriations included encouraging others to generalize a particular claim or conjecture, including prompting for expansion beyond the case at hand, searching for a relation with other mathematical objects, and building on another member's contributions.

Other studies are more explicitly focused on proof of generalizations. Maher and Martino (1996) traced the development of one child's reasoning over a 5-year span (Grade 1 through 5) as she participated in classrooms of literate mathematical practice. A trace of conceptual change was obtained by asking Stephanie to figure out how many different towers four or five cubes tall can be made if one selects among red and blue cubes. In the third grade, Stephanie attempted to generate cases of combination and eliminate duplicates. Her justification for claiming that she had found all possible towers was that she could not generate any new ones. By the spring of the fourth grade, Stephanie was no longer content with mere generation and instead constituted an empirical proof by developing a way to exhaustively search all the possibilities.

Another longitudinal study followed the student quilt designers who had discovered the limits of case-based generalization for transformations of units in the second grade. The following year (Grade 3) these students investigated all the possible arrangements of squares about a point that could be folded to make a cube (Lehrer, Kemeny, & Gance, 1996). Although their initial approach was to generate cases, they were unsettled to find that their cases included novel configurations (nets) they had not seen before. How, then, could they know when they had found all of the possible configurations? The result of their investigation is depicted in Figure 13.1, which depicts a

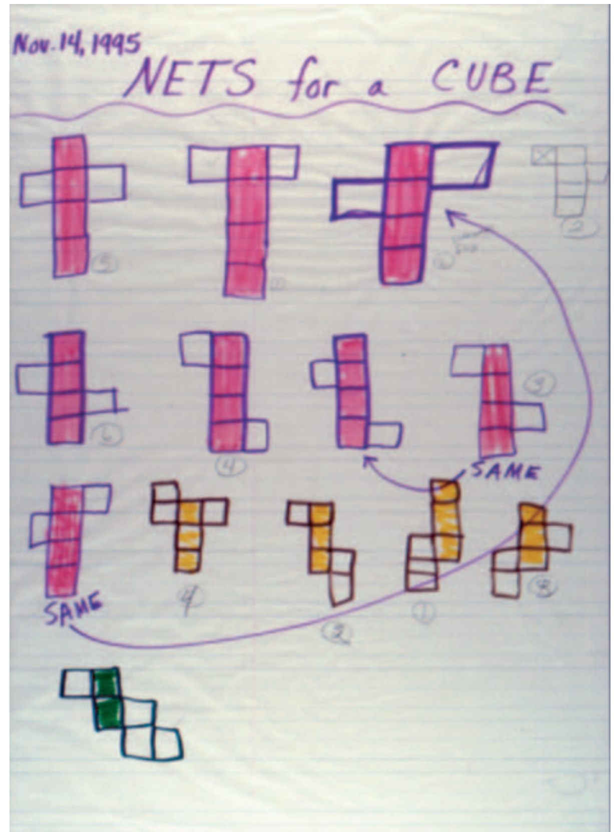


Figure 13.1 A third-grade proof of the number of possible nets of a cube

"system" of exhaustive search organized by column height of the net (4, 3, 2), and proves that there could be only 11 solutions. As they generated this proof by exhaustion, students also considered other important mathematical ideas, such as equivalence, because the proof relied on prior definition of uniqueness. If one configuration could be achieved by rotating, reflecting, and/or translating another, children judged them as equivalent.

Maher (2009) followed two third-grade children as they investigated the number of unique configurations of a two-color tower of four cubes. Children first simply generated towers and tested each to determine if it had been constructed previously. This strategy resulted in 16 towers, but only 15 were distinct. A researcher-teacher asked students if they were convinced that they had found all the towers and whether they could convince others that they. The need to convince others led to proposals for ways to "organize" the towers. The students also had to judge whether solutions were equivalent, and ultimately decided that the color configuration was identical when one of the towers and its pair was flipped. This led to a discovery of 16 towers when students recognized that one of the pairs was missing its oppositional component. The teacher-researcher further emphasized the role of proof by asking students how they planned to convince people that there were not 17 towers. This question seemed to provoke an argument by contradiction: 17 towers could be generated only by violating the constraint of four on the height of the tower. Maher (2009) concluded that the need to convince others and the questions posed by the teacher-researcher together made proof possible. A common feature of these proofs is that the problem investigated could be solved by exhaustive search of combinations that children were capable of generating.

Fosnot and Jacobs (2009) also reported elementary children participating in "communities of discourse" who were extraordinarily sensitive to the grounds and production of proof (p. 102). Second-graders developed relations of equivalence among different symbolic expressions of the total represented by sums of pennies, nickels, dimes, and quarters. During the course of conversation, children were encouraged to treat expressions (e.g., $3p + n + d + q$) as analytic objects, rather than invitations for doing arithmetic, so that "I know I have more than Devin. I know without counting" (p. 105) were often inferred by comparing expressions instead of computing these quantities directly. Children also explored changes to the status of equivalence among expressions if the same quantity was added to each. Similar advances from a focus on calculation to symbolic generalization and proof were noted with fifth-grade students working with a double number line who were investigating problems involving inverse relations among arithmetic operations.

These impressive forms of reasoning in the elementary grades are also evident in studies of secondary students when the students are participating in well-designed and -conducted settings. For example, Herbst (2005) observed proof practices in eight high school geometry classes, tracking the activity of four students as they solved a problem involving construction of triangles with equal area and then proof that the resulting areas were, in fact, equal. These classrooms were characterized by developing public knowledge and extensively discussing the reasonableness and intelligibility of proofs invented by students. For the students closely observed (via transcription of discourse), the activity of proving involved developing different and increasingly sophisticated conceptions of area (e.g., equivalent area as global congruence of regions of space, equivalent area as equivalent quantities). As in the studies with younger children, proof, "while oriented to justifying or explaining, also shapes what the objects of inquiry mean" (Herbst, 2005, p. 13).

As one might expect, there are counterpart studies in postsecondary education. For example, Larsen and Zandieth (2008) employed principles of realistic mathematics education (Freudenthal, 1973; Gravemeijer, 1999) to design instruction in abstract algebra that emphasized guided reinvention of concepts of group. Their analysis of the resulting classroom dialogue suggested that the historic processes of proof described by Lakatos (1976) had counterparts in the reasoning of students participating in this designed learning environment. Especially noteworthy were the efforts by students to successfully modify a proof in light of a counterexample proposed by their teacher, a form of activity characterized by Lakatos (1976) as proof analysis (See also, Zandieh & Rasmussen, 2010).

Reprise of Mathematical Argument in Light of Dialogic Design

Mathematical argument emphasizes generality and certainty about patterns and is supported by cognitive capacities to represent possibility and to reason counterfactually about possible patterns. These capacities seem to be robustly supported by cultural practices such as pretense and storytelling. Nevertheless, dispositions to construct mathematically sound arguments apparently do not arise spontaneously in traditional schooling or in everyday cultural practices. Mathematical forms such as proof have their genesis in classrooms that are dialogic and that interleave collective and individual development of conjecture, justification, and explanation. These forms of thinking demand high standards of teaching practice, because although students may be the primary authors of these arguments, it is the teachers who orchestrate them. Teaching practices are supported by mathematics knowledge for teaching, although this knowledge is not identical to conversational practices such as expanding selected utterances by students or establishing and monitoring a common conversational ground. Classroom dialogue can spawn overlapping epistemologies; students can be oriented toward mathematics as structure and pattern while they simultaneously examine the grounds of knowledge. Ideally, pattern and proof epistemologies co-originate in classrooms, because pattern provides the grounds for proof and proof the rationale for pattern. Thus, classroom conversation and dialogue constitute one possible genetic pathway toward the development of proof reasoning skills and an appreciation of the epistemology of generalization. Yet, even as we emphasize dialogue and language, we are struck by the role played by symbolization and tools in the development of arguments in classrooms and in mathematical practice. Consider, for example, the coordination of proof and inscription in the investigations by the third-graders depicted in Figure 13.1. This is not surprising when one considers the central historical role of symbolizations in mathematics. We turn next to considering a complementary genetic pathway to developing mathematical knowledge, one in which students are conceived as writers of mathematics.

INSCRIPTIONS AND VISUALIZATIONS

In this section we explore the invention and appropriation of inscriptions (literal marks on paper or other media, following Latour, 1990) and the expansion of the writing space generated by digital media producing mediational tools that can transform mathematical activity. This view follows from our emphasis in the previous section on mathematics as a discursive practice in which everyday resources, such as conversation and pretense, provide a genetic pathway for the development of an epistemology of mathematical argument, of literally talking mathematics into being (Sfard, 2000, 2008; Sfard & Kieran, 2001). Here we focus on the flip side of the coin, portraying mathematics as a particular kind of written discourse—"a business of making and remaking permanent inscriptions . . . operated upon, transformed, indexed, amalgamated" (Rotman, 1993, p. 25). Rotman distinguished this perspective from a dualist view of symbol and referent as having independent existence, proposing instead that signifier (inscription) and signified (mathematical idea) are "co-creative and mutually originative" (p. 33). Accordingly, we first describe perspectives that frame inscriptions as mediators of mathematical and scientific activity, with attention to sociocultural accounts of inscription and argument. These accounts of inscription buttress the semiotic approach taken by Rotman (1988, 1993) and set the stage for cognitive studies of inscription. We proceed, then, to describe children's efforts to invent or appropriate inscriptions in everyday contexts such as drawing or problem solving. Collectively, these studies show that the growth of representational competence, as reviewed in the previous section, is mirrored by a corresponding competence in the uses of inscription and notation. In other words, the having of ideas and the inscribing of ideas co-evolve. Studies of inscriptionally mediated thinking in mathematics demonstrate that mathematical objects are created as they are inscribed. This perspective calls into question typical accounts in cognitive science, where inscriptions are regarded as simply referring to, rather than constituting mathematical objects. We conclude this section with the implications of these findings for an emerging arena of dynamic inscriptions, namely, computational media.

Disciplinary Practices of Inscription and Notation

Studies in the sociology of science demonstrate that scientists invent and appropriate inscriptions as part of their everyday practice (Latour, 1987, 1990; Lynch, 1990). Historically, inscription and notation have played important roles in the quantification of natural reality (Crosby, 1997) and are tools for modeling the world on paper (Olson, 1994). DiSessa (2000, p. 19) noted, "Not only can new inscription systems and literacies ease learning, as algebra simplified the proofs of Galileo's theorems, but they may also rearrange the entire terrain. New principles become fundamental and old ones become obvious. Entirely new terrain becomes accessible, and some old terrain becomes boring."

Visualizing Nature

One implication is that even apparently individual acts of perceiving the world, such as classifying colors or trees, are mediated by layers of inscription and anchored to the practices of disciplinary communities (Goodwin, 1994, 1996; Latour, 1986). Goodwin (1994) pointed out that inscriptions do not mirror discourse in a discipline, but complement it, so that professional practices in mathematics and science use "the distinctive characteristics of the material world to organize phenomena in ways that spoken language cannot—for example, by collecting records of a range of disparate events onto a single visible surface" (p. 611). For example, archaeologists classify a soil sample by layering inscriptions, field practices, and particular forms of talk to render a professional judgment (Goodwin, 2000). Instead of merely looking, archaeologists juxtapose the soil sample with an inscription (the Munsell color chart) that arranges color gradations into an ordered grid, and they spray water on the soil to create a consistent viewing environment. These practices format discussion of the appropriate classification and illustrate the moment-to-moment embedding of inscription within particular practices.

Repurposing Inscription

Inscriptions in scientific practice are not always stable, but instead can be repurposed in new systems of explanation. For example, Kaiser (2000) examined the long-term history of physicists' use of Feynman diagrams. Initially, these diagrams were invented to streamline and make visible computationally intensive components of quantum field theory. They drew heavily on a previous inscription, Minkowski's space-time diagrams, which lent an interpretation of Feynman diagrams as literal trajectories of particles through space and time. Physicists knew perfectly well that the trajectories so described did not correspond to reality, but that interpretation was a convenient fiction, much as physicists often talk about subatomic particles as if they were macroscopic objects (e.g., Ochs, Gonzales, & Jacoby, 1996; Ochs, Jacoby, & Gonzales, 1994). Over time, the theory for which Feynman developed his diagrams was displaced, and a competing inscription tuned to the new theory, *dual diagrams,* was introduced. Yet despite its computational advantages, the new inscription (dual diagrams) never replaced the Feynman diagram. Kaiser suggested that the reason was that the Fenyman diagrams had visual elements in common with the inscriptions of paths in bubble chambers, and this correspondence again had an appeal to realism:

> Unlike the dual diagrams, Feynman diagrams could evoke, in an unspoken way, the scatterings and propagation of real particles, with "realist" associations for those physicists already awash in a steady of bubble chamber photographs, in ways that the dual diagrams simply did not encourage. (pp. 76–77)

Hence, scientific practices of inscription are saturated with epistemic stances toward the world and thus cannot be understood outside of these stances.

Inscription and Argument

Nevertheless, Latour (1990) noted that systems of inscription, whether they are about archaeology or particle physics, share properties that make them especially well suited for mobilizing cognitive and social resources in service of argument. His candidates include (a) the literal mobility and immutability of inscriptions, which tend to obliterate barriers of space and time and fix change, effectively freezing and preserving it so that it can serve as the object of reflection; (b) the scalability and reproducibility of inscriptions, which guarantee economy even as they preserve the configuration of relations among elements of the system represented by the inscription; and (c) the potential for recombination and superimposition of inscriptions, which generate structures and patterns that might not otherwise be visible or even conceivable. Lynch (1990) reminded us, too, that inscriptions not only preserve change, but edit it as well. Inscriptions reduce and enhance information. For example, a diagram often highlights some elements of a situation and obliterates or downplays others. In the next section, we turn toward studies of the development of children as inscribers, with an eye toward continuities (and some discontinuities) between inscriptions in scientific and everyday activity.

The Development of Inscriptions as Tools for Thought

Children's inscriptions range from commonplace drawings (e.g., Goodnow, 1977) to symbolic relations among maps, scale models, and pictures and their referents (e.g., DeLoache, 1987) to notational systems for music (e.g., Cohen, 1985), number (e.g., Munn, 1998), and the shape of space (Newcombe & Huttenlocher, 2000). These inscriptional skills influence each other so that collectively, children develop an ensemble of inscriptional forms (Lee & Karmiloff-Smith, 1996). Consequently, by the age of 4 years children typically appreciate distinctions among alphabetical, numerical, and other forms of inscription (Karmiloff-Smith, 1992). Somewhat surprisingly, children invent inscriptions as tools for a comparatively wide range of circumstances and goals. Cohen (1985) examined how children ranging in age from 5 to 11 years created inscriptions of musical tunes they first heard and then attempted to play with their invented scores. She found that children produced a remarkable diversity of inscriptions that did the job. Moreover, a substantial majority of the 8- to 11-year-olds created the same inscriptions for encoding and decoding. Their inscriptions adhered to one-to-one mapping rules so that, for example, symbols consistently had one meaning (e.g., a triangle might denote a brief duration) and each meaning (e.g., a particular note) was represented by only one symbol. Both of these properties are hallmarks of conventional systems of notation (e.g., Goodman, 1976).

Other studies of cognitive development focus on children's developing understandings and uses of inscription for solving puzzle-like problems. Karmiloff-Smith (1979) had children (7 to 12 years) create an inscriptional system that could be used as an external memory for driving (with a toy ambulance) a route with a series of bifurcations. Children invented a wide range of adequate mnemonic marks, including maps, routes (e.g., R and L to indicate directions), arrows, weighted lines, and the like. Often, children changed their inscriptions during the course of the task, suggesting that children transform inscriptions in response to local variation in problem solving. All of their revisions in this task involved making information that was initially implicit, albeit economically rendered, explicit (e.g., adding an additional mark to indicate an acceptable or unacceptable branch), even though the less redundant systems appeared adequate to the task. Karmiloff-Smith (1992) proposed that these inscriptional changes reflected change in internal representations of the task. An alternative interpretation is that children became increasingly aware of the functions of inscription, so that in this task with large memory demands, changes to a more redundant system of encoding provided multiple cues and so lightened the burden of decoding—a tradeoff between encoding and decoding demands.

Communicative considerations are paramount in other studies of children's revisions of inscriptions. For example, both younger (8 to 9 years) and older (10 to 11 years) children adjusted inscriptions designed as aides for others (a peer or a younger child) to solve a puzzle problem in light of the age of the addressee (Lee, Karmiloff-Smith, Cameron, & Dodsworth, 1998). Compared with adults, younger children were more likely to choose minimal over redundant inscriptions for the younger addressee, whereas the older children were equally likely to choose either inscription. Overall, there was a trend for older children to assume that younger addressees might benefit from redundancy. Danish and Enyedy (2007) examined initial inscriptions and subsequent revisions to these inscriptions as kindergarten and first-grade students created representations of pollination. They concluded that revisions to inscriptions were motivated by several factors, including increasing knowledge of the process of pollination as well as the reactions of peers and teacher to the intelligibility and correspondence to important details of the process of pollination of these student inventions. They stress, too, that personal preferences, albeit modified during the course of interpersonal interactions, played a continuous role in children's productions. In a series of studies with older children (sixth grade through high school), diSessa and his colleagues (diSessa, 2004; diSessa, Hammer, Sherin, & Kolpakowski, 1991) investigated what students know about inscriptions in a general sense. They found that, like younger children, older children and adolescents invented rich arrays of inscriptions tuned to particular goals and purposes. Furthermore, participants' inventions were guided by criteria such as parsimony, economy, compactness (spatially compact inscriptions were preferred), and objectivity (inscriptions sensitive to audience, so that personal and idiosyncratic features were often suppressed). Collectively, studies of children's development show an emerging sense of the uses and skills of inscription across a comparatively wide range of phenomena. Invented inscriptions are generative and responsive to aspects of situation. They are also effective: They work to achieve the goal at hand. Both younger and older children adapt features of inscriptions in light of the intended audience, suggesting that there is an early distinction between idiosyncratic and public functions of inscription. Children's invention and use of inscriptions are increasingly governed by an emerging meta-knowledge about inscriptions, which diSessa (2004) termed *metarepresentational competence*. Such capacities ground the deployment of inscriptions for mathematical activity, although we shall suggest, as we did for argument, that if mathematics and inscription are to emerge in coordination, careful attention must be paid to the design of mathematics education.

Inscriptions as Mediators of Mathematical Activity and Reasoning

Inscriptions mediate mathematical activity and reasoning. Inscriptions are not mere records of previous thought or simple conveniences for syntactic manipulation. In this section we trace the ontogenesis of this form of mediated activity, beginning with children's early experiences with parents and culminating with classrooms where inscriptions are recruited to create and sustain mathematical arguments.

Early Development

Van Oers (2000, 2002) claimed that early parent-child interactions and play in preschool with counting games set the stage for fixing and selecting portions of counting via inscription. In his account, when a child counts, parents have the opportunity to interpret that activity as referring to cardinality instead of mere succession. For example, as a child completes his or her count, perhaps a parent holds up fingers to signify the quantity and repeats the last word in the counting sequence (e.g., 3 of 1, 2, 3). This act of inscription, although perhaps crudely expressed as finger tallies, curtails the activity of counting and signifies its cardinality. As suggested by Latour (1990), the word or tally (or numeral) can be transported across different situations, such as three candies or three cars, so number becomes mobile as it is recruited to situations of "how many." Similarly, Sfard (2008) advises that numbers are reifications of the process of counting, so that the number-words become shortcuts for the action of counting, and are objectified by numerals or tallies. Pursuing the role of inscription in developing early number sense, Munn (1998) investigated how preschool children's use of numeric notation might transform their understanding of number. She asked young children to participate in a "secret addition" task. First children saw blocks in containers, and then they wrote a label for the quantity (e.g., with tallies) on the cover of each of four containers. The quantity in one container was covertly increased, and children were asked to discover which of the containers had been incremented. The critical behavior was the child's search strategy. Some children guessed, and others thought that they had to look in each container and try to recall its previous state. However, many used the numerical labels they had written to check the quantity of a container against its previous state. Munn found that over time, preschoolers were more likely to use their numeric inscriptions in their search for the added block to compare past and current quantities. In her view, children's notations transformed the nature of their activity, signaling an early integration of inscriptions and conceptions of number. Co-constitution of conceptions of number and inscription may also rely on children's capacity for analogy. Brizuela (1997) described how a child in kindergarten came to understand positional notation of number by analogy to the use of capital letters in writing. For this child, the 3 in 34 was a "capital number," signifying by position in a manner reminiscent of signaling the beginning of a sentence with a capital letter.

Microgenetic Studies of Appropriation of Inscription

The co-creation of mathematical thought and inscription is elaborated by microgenetic studies of individuals' mathematical activity in a diverse range of settings. Hall (1990, 1996) investigated the inscriptions generated by algebra problem solvers (ranging from middle school to adult participants, including teachers) during the course of solution. He found that the quantitative inferences made by solvers were obtained within representational niches defined by interaction among varied forms of inscription (e.g., algebraic expressions, diagrams, tables) and narratives, not as a simple result of parsing strings of expressions. These niches or material designs helped participants visualize relations among quantities and stabilized otherwise shifting frames of reference. Co-evolution of inscription and thinking was also prominent in Meira's (1995, 2002) investigations of (middle school) student thinking about linear functions that describe physical devices, such as winches or springs. His analysis focused on student construction and use of a table of values to describe relations among variables such as the turns of a winch and the distance an object travels. As pairs of students solved problems, Meira (1995) noted shifting signification, reminiscent of the role of the Feynman diagrams, in that marks initially representing weight shifted to represent distance. He also observed several different representational niches (e.g., transforming a group of inscriptions into a single unit and then using that unit in subsequent calculation), a clear dependence of problem-solving strategies on qualities of the number tables, and a lifting away from the physical devices to operations in the world of the inscriptions—a way of learning to see the world through inscriptions. Izsak (2000) found that pairs of eighth-grade students experimented with different possibilities for algebraic expressions as they explored the alignment between computations on paper and the behavior of the winch featured in the Meira (1995) study. Pairs also negotiated shifting signification between symbols and aspects of device behavior, suggesting that interplay between mathematical expression and qualities of the world may constitute one genetic pathway for mediating mathematical thinking via inscriptions. (We revisit this theme again in the section on mathematical modeling.)

In their studies of student appropriation of graphical displays, Nemirovsky and his colleagues (Nemirovsky & Monk, 2000; Nemirovsky, Tierney, & Wright, 1998) claimed that learning to see the world through systems of inscription is more accurately described as a fusion between signifiers and signified. In their view, coming to interpret an inscription mathematically often involves treating the signifiers and the signified as undifferentiated, even though one knows very well that they can be treated distinctly (the roots of these capabilities are likely found in pretense and possibility, as previously described). In their studies of students' attempts to interpret graphical displays of physical motion, Nemirovsky and colleagues recounted an instance of teacher scaffolding by using "these" to refer simultaneously to lines on a graph, objects (toy bears), and a narrative in which the bears were nearing the finish of a race. This referential ambiguity helped the student create an interpretation of the inscription that was more consistent with disciplinary practice as she sorted out the relations among inscription, object, and the ongoing narrative that anchored use of the inscription to a time course of events.

According to Stevens and Hall (1998), mathematical learning mediated by inscription is tantamount to disciplining one's perception: coming to see the inscription as a mathematical marking consistent with disciplinary interpretations, rather than as a material object consistent with everyday interpretations. That such a specialized form of perception is required is evident in the confusions that even older students have about forms of notation like the graph of a linear function. For example, a student's interpretation of slope in a case study conducted by Schoenfeld, Smith, and Arcavi (1993) included a conception of the line as varying with slope, y-intercept, and x-intercept. The result was that the student's conception of slope was not stable across contexts of use. Stevens and Hall traced the interventions of a tutor who helped an eighth-grade student working on similar interpretation problems with graphical displays. Their analysis focused on the tutoring moves that helped reduce the student's dependence on a literal grid representing Cartesian coordinates. Some of the teacher's assistance included literal occlusion of grid, a move designed to promote disciplinary understanding by literally short-circuiting the student's reliance on the grid in order to promote a disciplinary focus on ratio of change to describe the line. Moschkovich (1996) examined how pairs of ninth-grade students came to discipline their own perceptions by coordinating talk, gestures, and inscriptions of slope and intercept. Inscriptions helped orient students toward a shared object of reference, and the use of everyday metaphors such as hills and steepness grounded this joint focus of conversation. Ultimately, the relative ambiguity of these everyday metaphors instigated (for some) a more disciplined interpretation, because meanings for these terms proved ambiguous in the context of conversation. However, not all pairs of students evolved toward disciplinary-centered interpretation, again suggesting the need for explicit instructional support.

Mathematical Inscriptions and Mathematical Thinking in Designed Environments

Research provides glimpses of invention and use of inscription in classrooms where the design of instruction supports students' invention and appropriation of varying forms of mathematical inscription. These studies are oriented toward a collective level of analysis (i.e., treating the class as a unit of analysis) because the premise is that, following Latour (1990), inscriptions mobilize arguments in particular communities, as suggested by Danish and Enyedy (2007). In these studies the community is the mathematics culture of the classroom. Moreover, "A focus on inscriptions requires traditional learning environments to be redesigned in such a way that students can appropriate inscription-related practices and discourses" (Roth & McGinn, 1998, p. 52). Cobb, Gravemeijer, Yackel, McClain, and Whitenack (1997) traced children's coordination of units of 10 and 1 in a first-grade class. Instruction situated investigation of these units and unit collections in a context of packaging candies. Arithmetic reasoning was constituted as a "chain of signification" (Walkerdine, 1988) in which unifix cubes first signified a quantity of candies packed in the shop and then this sign (the unifix cubes–candies relation) was incorporated as a signified of various partitions of candies inscribed as pictured collections. At this point the structure of the collection, rather than the original packaging of candy, became the object of thinking. The structure of the collection, in turn, served as the signified of yet another signifier, a notational rendering of collections as, for instance, 3r13c (3 rolls, 13 candies). Cobb et al. (1997) noted that this rendering served as the vehicle by which the pictured collections became models of arithmetic reasoning (also see Gravemeijer, Cobb, Bowers, & Whitenack, 2000).

Kemeny (2001) examined the collective dialogic processes during a lesson in which a third-grade teacher helped students construct the mathematical object referred to by the inscription of the Cartesian system. Her analysis underscores the interplay between collective argument and inscription. It also highlights the role of the teacher's orchestration of conversation and inscription. First, the teacher introduced a new signifier, drawing the axes of the coordinate system on the blackboard, and invited students to consider whether it might be a good tool for thinking about relationships between the sides of similar rectangles. Because these students had a prior history of investigating ratio concepts via the study of geometric similarity (Lehrer, Strom, & Confrey, 2002), the introduction of the signifier (the inscription) created an opportunity for students to create the signified—the Cartesian grid (see Sfard, 2000). Children's first attempts to generate a signified were based on projecting metaphors of measure. They decided, for example, that the lengths of the axes should be subdivided into equal measures and that this subdivision implied an origin labeled numerically as zero, because movement along the axis was a distance, not a count. They debated where this origin should be placed and generated several valid alternatives. At this point, the teacher stepped in to introduce a conventional interpretation of origin, which students accepted as sensible. Some students then transported a practice they had generated in previous investigations, superimposing paper models of similar rectangles to observe their growth/shrinkage, to the axes on the blackboard. On the axes, they draw rectangles that mimicked the paper material, a move that invited consideration of the axes as a literal support (and raised questions about what to label them). However, it also inspired one student to notice a stunning possibility—a rectangle might be represented by one of its vertices. Perhaps there was no need to draw the whole thing! Their teacher promptly seized on this suggestion, and the students went on to explore its implications. Eventually, they concluded that there could be as many rectangles as they liked, not just the cases initially considered, and that all similar rectangles could be represented and generated as a line through the origin. Inscription, the Cartesian coordinate system and argument, the generalization about similar figures, co-originated. The inscription did not spring out of thin air, but it became a target of metaphoric projection and extension and was ultimately treated as an object in its own right. The construction of this object (the Cartesian system) invited a format for generalization, the line representing all rectangles, and also an epistemology of pattern. The students accepted what was true for three or four cases as true for infinitely many. Over the course of several lessons, students' inscriptions of similarity as numeric ratio, as algebraic pattern (e.g., the class of similar rectangles described by $LS = 3 \times SS$, where LS and SS refer to "long side" and "short side," respectively), and as a line in the Cartesian system created a resonance among inscriptional forms. Thus, mathematical generalization was expressed in three distinctive forms of inscription, and the equivalence of these forms invited construction that spanned all three (Lehrer et al., 2000).

The lesson analyzed by Kemeny (2001) was anchored in a history of inscription in the classroom (Lehrer, Jacobson, Kemeny, & Strom, 1999; Lehrer & Pritchard, 2002). The norms in the classroom included a stance toward adopting inscriptions as tools for thinking and, further, toward assuming that no inscription would be wasted. That is, if students developed a stable (and public) system of mathematical inscription, they could reasonably expect to use it again. One opportunity of this kind occurred later in the year when students conducted investigations about the growth of plants. Lehrer, Schauble, Carpenter, and Penner (2000) described students' inscriptions of plant growth during successive phases of inquiry over the course of approximately three months. The investigators found a reflexive relationship between children's inscriptions of and their ideas about growth. Over time, children either invented or appropriated inscriptions that increasingly increased the dimensionality of their models of growth. For example, initial inscriptions were one-dimensional records of height, but these were later supplanted by models of plant volume that incorporated variables of height, width, and depth, sequenced chronologically to facilitate test of the conjecture that plant growth was an analogue of geometric growth (it was not). Inscription and conception of growth were fused in the sense proposed by Nemirovsky and his colleagues (Nemirovsky & Monk, 2000; Nemirovsky, Tierney, & Wright, 1998), in that students' notions of growth were tied to their experiences of producing and negotiating its inscriptions.

Notation: A Privileged Inscription

Developmental studies of children's symbolization, microgenetic studies of individuals' efforts to appropriate inscription, and collective studies of classrooms where inscriptions are recruited to argument describe how the interactive constitution of inscription and mathematical objects serves as a complementary genetic pathway for the development of mathematical reasoning. These studies also suggest the cognitive and social virtues of privileging notations, such as the Cartesian system, among inscriptions. Goodman (1976) suggested heuristic principles to distinguish notational systems from other systems of inscription. The principles govern relations among inscriptions (signifiers–literal markings), objects (signified), character classes (equivalent inscriptions, such as different renderings of the numeral 7), and compliance classes (equivalent objects, such as dense materials or emotional people). Two principles govern qualities of inscriptions that qualify as notation: (1) syntactic disjointedness, meaning that each inscription belongs to only one character class (e.g., the marking 7 is recognized as a member of a class of numeral 7s, but not numeral 1s); and (2) syntactic differentiation, meaning that one can readily determine the intended referent of each mark (e.g., if one marked quantity with length, then the differences in length corresponding to differences in quantity should be perceived readily). Two other principles regulate mappings between character classes and compliance classes. The first is that all inscriptions of a character class should have the same compliance class, which Goodman referred to as a principle of unambiguity. For example, all numeral 7s should refer to the same quantity, even though the quantity might be comprised of seven dogs or seven cats. It follows, then, that character classes should not have overlapping fields of compliance classes—the principle of semantic disjointedness. For example, the numeral 7 and the numeral 8 should refer to different quantities. This requirement rules out natural language's intersecting categories, such as whale and mammal. Finally, a principle of semantic differentiation indicates that every object represented in the notational scheme should be able to be classified discretely (assigned to a compliance class)—a principle of digitalization of even analog qualities. For example, the quantities 6.999 and 7.001 might be assigned to the quantity 7, either as a matter of practicality or as a matter of necessity before the advent of a decimal notation.

Because they possess these features, notational systems can be treated as things in themselves, and one can perform operations on the symbols without regarding what they refer to. This capacity for symbolically mediated generalization creates a new faculty for mathematical reasoning and argument (Kaput, 1991, 1992; Kaput & Schaffer, 2002). For example, the well-formedness of notations makes algorithms possible and transforms ideas into computations (Berlinski, 2000). Notational systems provide opportunity for students to express mathematical ideas, but systematicity places fruitful constraints on that expression (Thompson, 1992). We have seen, too, how notations transform mathematical experiences genetically, both over the life span (from early childhood to adulthood) and over the span of increasing expertise (from novices to professional practitioners of mathematics and science). Consider, for example, the van Oers (2000, 2002) account of parental scaffolding to notate children's counting. This marking objectifies counting activity so that it becomes more visible and entity-like. The use of a symbolic system for number foregrounds the quantity that results from the activity of counting and backgrounds the counting act itself. This separation of activity (counting) from its product (quantity) sets the stage for making quantity a substrate for further mathematical activities, such as counts of quantities as exemplified in the Cobb et al. (1997) study of first graders. Microgenetic studies like those of Hall (1990) and Meira (1995) reveal that inscriptions tend to drift over time and use toward notations that stabilize interactions among participants. The classroom studies by Kemeny (2001) and Lehrer et al. (2000) also found a press toward notation as a means of fixing, selecting, and composing mathematical objects as tools for argument. These studies, however, concentrate largely on the world on paper, so in the next section we address the implications of electronic technologies for bootstrapping the reflexive relation between conception and inscription.

Dynamic Notations

The chief effect of electronic technologies is the corresponding development of new kinds of notational systems, often described as *dynamic* (Kaput, 1992). The manifestations of electronically mediated notations are diverse, but what they share in common is an expression of mathematics as computation (Noss & Hoyles, 1996). DiSessa (2000) argued that computation is a new form of mathematical literacy and that computation, especially programming, "turns analysis into experience and allows a connection between analytic forms and their experiential implications" (p. 34). Moreover, simulating experience is a pathway for building students' understanding, yet it is also integral to the professional practices of scientists and engineers. For example, B. Sherin (2001) explored the implications of replacing algebraic notation with programming for physics instruction. For students, programming computational expressions of motion afforded more ready expression of time-varying situations that, in turn, instigated a shift in their conceptions of these situations from an algebraically guided physics of balance and equilibrium to a physics of process and cause.

Resnick (1994) pointed out that introducing students to parallel programming (e.g., multiple screen agents) provides an opportunity to develop mathematical descriptions at multiple levels and to understand how levels interact. Wilensky and Resnick (1999) noted the difficulties that people have in comprehending levels of phenomena such traffic jams. At one level, traffic jams result from cars moving forward, but the interactions among cars create jams that proliferate backward. This effect seems at first glance to violate common sense, so it is hard for people to comprehend, but dynamic notations such as multi-agent programming give students new tools for thinking about relations between the actions of local agents and emerging, aggregate levels of description.

Dynamic notations, built into tools such as Sketchpad (Jackiw, 1995) and Cabri (Laborde & Laborde, 1991), generate a new form of geometry and of geometrical thinking, where motions, such as "dragging" a constructed object, affords a closer tie between doing and reflecting on the results of one's actions (Goldenberg, Cuco, & Mark, 1998). Many studies indicate that the distinction between drawing and constructing a figure, a distinction enabled by dynamic geometry tools, constitutes a form of instructional capital. Constructions that can be subjected to motion afford systematic experimentation, and this capacity for experimentation can be instructionally focused to a search for an explanation of the invariants observed (Arcavi & Hadas, 2000; de Villiers, 1998; Olive, 1998). Arcavi and Hadas (2000) described instructional support for the use of dynamic geometry tools to model situations, with particular attention to how symbolic expression of function is informed by systematic experimentation. Chazan (1993) found that the use of construction geometry tools, in concert with instruction that supported student conjecturing, helped high school students become more aware of distinctions between empirical and deductive forms of argument. Baccaglini-Frank and Maroitti (2010) suggest considering learning with these tools as an instance of "instrumented argument" (p. 247). Instrumented argument refers to the dependencies of a conjecture or observation about mathematical objects, such as the properties of a constructed figure, on the use of the tools provided by the software.

Baccaglini-Frank and Maroitti explain that dragging allows students to experience a motion dependency between an element selected and dragged and other elements that appear to move as well. The key for learners is to consider how the motion dependency is a result of a logical dependency. In studies with high school students, they found that dragging with the intention of preserving properties of a figure was particularly useful for generating fruitful conjectures.

The use of dynamic tools for visualization now pervades many realms of mathematical activity. Consider, for example, the well-established difficulties that students experience in statistics education with understanding relations among samples, populations, and uncertainty (Liu & Thompson, 2002). New visualization tools help students coordinate these often problematic relations. Agent-based approaches are increasingly employed to visualize relations among individual agents that act randomly with their emerging aggregation into distribution. For example, Wilensky (2003) described how high school students employed NetLogo to explain how particle-agents moving in random directions could account for distribution of speeds of molecules in an ideal gas. Abrahamson & Wilensky (2007) described systematic agent-based modeling activities in which middle school students treated sample spaces as manipulable,

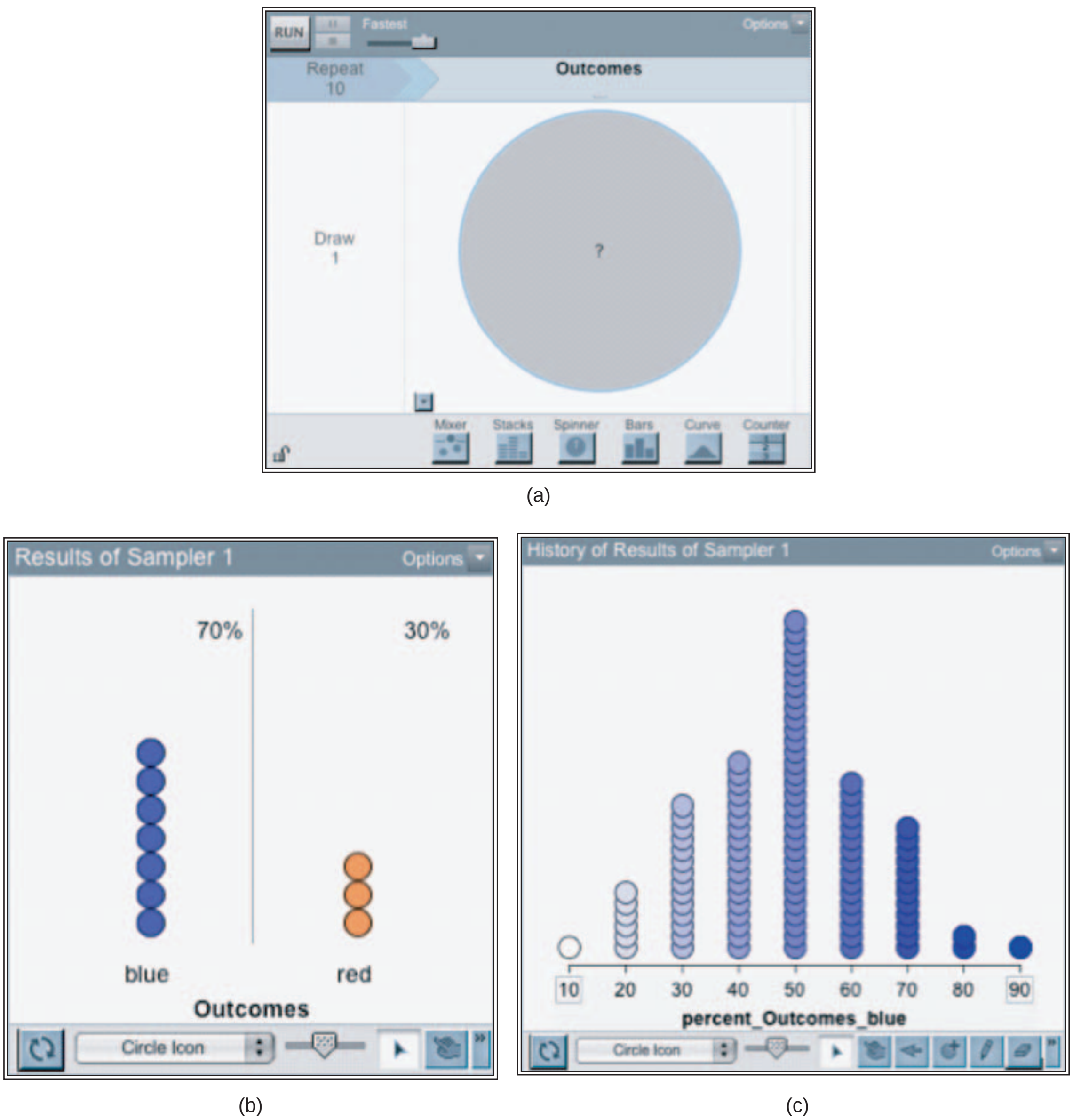


Figure 13.2 (a, b, c) Hidden spinner set to generate 10 repetitions of the process. Outcomes of 10 trials of one sample and an empirical sampling distribution of samples generated in the same manner.

computational objects that bridged between theoretical and empirical probabilities (see also Pratt, 2000).

Agent-based tools like NetLogo are complemented by other approaches to dynamic manipulation, such as TinkerPlots (Konold & Miller, 2005), that also support student learning of relations among cases and aggregates and between theoretical and empirical estimates of probability. Consider, for example, the panel (a) of Figure 13.2, a two-color, red-blue spinner with an unknown structure and hence, an unknown theoretical probability. Panel (b) provides the results of 10 spins. On its basis, one might guess that the probability of blue is 0.7. Panel (c) provides an empirical sampling distribution of repeated runs of this 10-trial experiment. Panel (c) helps one visualize sample-to-sample variability and emphasizes that chance refers to outcomes of a long-term, repeated process, so that the original estimate of 0.7 is unlikely, although not impossible. With tools like these, students have the opportunity to develop conceptions of statistics, data, and chance that would previously have been reserved for those considerably older (Konold & Lehrer, 2008).

The dynamic geometry and dynamic statistics tools that we have considered provide new forms for inscribing and visualizing mathematics. Perhaps their greatest potential is the affordances they provide for a mathematical middle ground, one that resides between mathematical experiment and mathematical structure. It is this middle ground to which we now turn, one where the resources of argument and inscription are harnessed to position learners to develop mathematical ideas and systems.

MODELING PERSPECTIVES ON MATHEMATICS LEARNING

During the decade since the first version of this chapter was written, investigations of children's mathematical models and modeling abilities have emerged as one of the most productive areas of mathematics education research. For example, modeling was featured in the problem solving chapter of the National Council of Teachers' of Mathematics' *Handbook of Research in Mathematics Education* (Lester, 2007); modeling was identified as a key 21st-century skill by the 14th international commission on mathematical instruction (Blum, Galbraith, Henn, & Niss, 2007); and, interest and scholarship in the field has generated an entire book series titled *International Perspectives on the Teaching and Learning of Mathematical Modeling* (e.g., Kaiser et al., 2011). Collectively, these volumes and associated research indicate that research on modeling is a thriving enterprise in more than 30 countries worldwide—with studies being distributed fairly equally among those that focus on (a) ways to make traditionally taught topics more useful outside of mathematics classrooms, (b) ways to help students develop more proficient modeling abilities, and (c) ways that students can use modeling to develop their own powerful mathematical concepts and abilities.

Considering point (a), concerning the reformulation of traditional mathematics, Usiskin (2007) illustrates how the arithmetic operations taught in elementary schools could be profitably elaborated and extended by developing them as models. For instance, considering multiplication as a scalar acting to stretch or shrink a quantity employs a geometric model of transformation (similarity) to help students visualize the meaning of multiplication beyond the traditional school emphasis on multiplication as repeated addition. Considering points (b) and (c), modeling as a means to develop dispositions toward the doing of mathematics, Swan, Turner, Yoon, and Muller (2007) found that modeling prompted the asking and answering of mathematical questions and provided opportunities for students to employ mathematical models and systems of representation as tools for solving problems ranging from paper engineering (e.g., pop-ups) to investigations of probability.

The general sense of these volumes is that activities involving modeling are proving to be remarkably effective means for promoting learning—especially for higher-order understanding of the small number of "big ideas" in any given course or grade level (Lesh & Doerr, 2003; Lehrer, Kim, & Schauble, 2007). Furthermore, models and modeling has become a central topic within the curricula of many European and Australasian countries, where more attention is being paid to new types of mathematical thinking that are needed by a well-educated workforce in a technology-based age (Maass & Gurlitt, 2011). Another factor drawing attention to modeling is that, during the past decade, engineering education has emerged as a significant endeavor within science and mathematics education (Zawojewski, Diefes-dux, & Bowman, 2009). Unlike earlier movements that focused on discovery learning, problem solving, constructivism, or problem-based learning, a curriculum focusing on models and modeling goes beyond specifying how mathematics should be learned to also include guidance about what should be learned, what it means to understand, how these understandings develop, and how these understandings can be documented and assessed (Lesh & Lamon, 1992). Yet, in the United States, even the newest *Common Core State*

Curriculum Standards are restricted to extremely limited notions of modeling: "Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace." In other words, this conception of modeling reduces it to applying traditionally taught concepts and skills without providing any guidance whatsoever to answer fundamental questions such as:

- How is model development related to competence in situations where new types of "mathematical thinking" should be useful beyond school in the 21st century?
- How is model development related to what it means to "understand" the small number of the most important "big ideas" that children are expected to learn during any given course or grade level?
- How is model development related to the mastery of "basic skills" of the type emphasized on standardized tests, which, in many countries, are emphasized in accountability assessments?
- How can children's understandings of powerful models and modeling capabilities be developed, documented, and assessed?

Bringing content-related issues like these to the forefront of curriculum reform is one of the most important outcomes that an emphasis on models and modeling adds to practices of argument, inscription, and visualization.

What Are Mathematical Models?

At their simplest, a model is a system for describing another system for some specific purpose. Models rest on analogies and metaphors (Hesse, 1962); and, mathematical models focus on the structural (or systemic) properties of the systems they are used to describe. Structural properties of systems are properties of the system-as-a-whole that cannot be deduced from properties of elements within the system. Sometimes, such as in studies focused on complex adaptive systems (Holland, 1995, 1998), these properties of the system-as-a-whole are referred to as emergent properties of the system. But, in fields ranging from physics to music, properties such as symmetry or centrality also are emergent properties of systems-as-a-whole. Or, in mathematics, properties of systems-as-a-whole include commutativity, associativity, reversibility, and transitivity—or other properties that are commonly used as "undefined terms" in the axiom systems that define different kinds of mathematical systems., For example, "points" and "lines" are undefined terms in the axioms that define Euclidean Geometry.

Axioms for Euclidean Geometry

1. A straight line can be drawn between any two points.
2. A finite line can be extended infinitely in both directions.
3. A circle can be drawn with any center and any radius.
4. All right angles are equal to each other.
5. Given a line and a point not on the line, only one line can be drawn through the point parallel to the line.

Note that points and lines participate in the axioms but are not explicitly defined, *all* of their mathematical meaning comes from the system-as-a-whole in which they reside. Similarly, "identity elements" (or "units") and "inverse elements" are instances of undefined terms within the axiom systems that define metric spaces or counting numbers (e.g., see Peano's Postulates).

Other examples of emergent properties of systems-as-a-whole occur because many relevant systems are not inert. They are dynamic—that is, they are moving and adapting. So, invariance under systems of transformations is another important category of emergent properties, as Piaget's various conservation tasks demonstrated (Lesh & Carmona, 2003). Other examples of emergent properties are associated with phenomena such as equilibrium states, maximization, minimization, stabilization, or feedback loops and second-order effects. What these observations imply is that models cannot be understood apart from their use, because it is by running models that one develops an appreciation of the system-as-a-whole. As we noted, this quality of emergence is commonplace in mathematics, but is rarely appreciated in mathematics teaching because the meaning of the system as a whole is generally developed over prolonged periods of time—rather via brief lectures.

How Does Modeling Interact With "Purer" Forms of Mathematical Thinking?

For centuries now, following the discovery of non-Euclidean geometries, mathematicians have been forced to abandon the notion that mathematics is about truth. Instead, they have settled for consistency. But this, too, has been challenged. For example, any system that includes the counting numbers generates questions that can be answered in mutually inconsistent ways. So the only way such systems can be shown to be internally consistent is to compare them to another system that is assumed to be completely understood (even though the consistency of this latter system can never be proven, either). What this problem implies is that mathematics settles for relative consistency—where the consistency of a system depends on the existence of a model that is assumed to be completely understood. For an intuitively accessible description of this problem and some of its consequences, see Hofstadter (1979).

Of course, the preceding kinds of epistemological crises are common in mature sciences. And, in mathematics, they can most readily be seen in the evolution of various number systems. In the beginning, there were "natural" numbers, which were assumed to be given in nature. Then, negative numbers were grudgingly added to the natural numbers; this entire collection required years to gradually be accepted as the integers. Similarly, fractions (derived from the root word *fractious,* meaning *quarrelsome*) took many years to be accepted as rational numbers; irrational numbers took many more years to be accepted as real numbers; and imaginary numbers took many years to be accepted as complex numbers. And, in each of the preceding cases, model development played a key role in establishing the social acceptability of new constructs (or number systems). So, even within the realm of pure mathematics, where theory stipulates what questions are legitimate to ask as well as stipulating what assumptions can be taken as starting points and what solution steps can be used, models play important roles in knowledge development. And, as modeling perspectives move into the foreground, new epistemological issues arise. Hence, we take the stance that metaphors and models are at the core of mathematics (Lakoff & Nunez, 2000), in spite of the fact that they are relegated to the status of application in some discussions.

Models are not about truth, nor are they about correctness. In fact, models are never more than useful simplifications of the systems they are intended to describe. So, in a sense, all models are wrong, or at best, incomplete. Yet, when purposes are clear, decisions can be made about whether one model is more or less useful than another, or about useful ways to select, modify, and integrate the most useful characteristics of alternative models (Lehrer & Schauble, 2006).

Another characteristic that distinguishes modeling from other forms of mathematical inquiry is that modeling problems tend to arise outside of any given theory; and, in realistically complex "real-life" situations, where there are conflicting constraints (e.g., low costs but high quality), as well as issues such as feedback loops and second-order effects, useful models often need to integrate ideas and procedures drawn from a variety of disciplines and textbook topic areas. For example, in comparison to scientists, what engineers deal with are situations where they seldom have enough time, money, or other resources—and where "clients" often hold partly conflicting goals. That is, "real-life" problem-solving tends to be problem solving under constraints; and these constraints and purposes tend to shape the nature of viable solutions at least as much as objectively given conditions. Furthermore, purposeful models often are embodied in tools and artifacts that need to be sharable and reusable. So, model development often needs to involve iterative sequences of express-test-revise cycles, and these cycles often induce significant changes in the worlds that future model development activities will need to understand and explain. In fact, in the 21st century, many of the most important things that impact the daily lives of ordinary people are systems that were designed or developed by humans. Therefore, being able to describe or design things mathematically is as important as computational and deductive competencies. So, learning to design, describe, analyze, and assess underlying models—as well as the artifacts and tools in which they are embodied—is emerging as one of the foremost literacies in modern societies.

Modeling is a form of argument, but one that culminates in model competition and revision, rather than in proof. Proofs can be generated about the mathematical objects and relations that constitute a model, but there can be no proof about the relation between the model and the system being modeled. For example, there can be proofs about complex numbers, but not about whether complex numbers are useful descriptions of particular situations.

In contrast to the preceding perspectives, for many people, modeling means teaching "applied mathematics topics" that have been thought about traditionally as being especially useful in fields outside of mathematics. Or, for others, emphasizing applications has meant "teaching mathematics so as to be useful" (Freudenthal, 1991) or "teaching in context," presumably so that students will recognize the utility of traditionally taught topics. However, our perspective is that curriculum materials focusing on models and modeling should treat modeling as a way for students to create mathematics (Lehrer & Schauble, 2004, 2005; Lesh & Caylor, 2007; Lesh & Doerr, 2003) rather that simply treating modeling as an opportunity to apply concepts already learned.

Designing for Modeling

Model invention and revision, like the other forms of practice, draws on native resources of argument and inscription. But it, too, needs to be cultivated. Not all educational environments will be fruitful incubators of this form of practice. However, research suggests several principles for establishing cultures of modeling in classrooms (Lesh, Hoover, Hole, Kelly, & Post, 2000). One is that the task or problems presented to students must be specified in ways that students can see the need for both initial and subsequent revisions of models (Lehrer & Schauble, 2007). Creating need has a basis in the tasks to be posed to students and in the development of classroom activity structures where models can be contested and revised (Lehrer & Schauble, 2000, 2002, 2004; Lesh & Doerr, 2011). Problem statements for effective model development activities should be similar to effective "design specs" like those given to engineers to build things like space shuttles (Zawojewski et al., 2009). Design specs should not dictate an appropriate design, but they should provide criteria that product designers can use to assess whether any design is good enough, along with criteria to assess strengths and weaknesses of alternative designs.

A second design principle is that students should express their ways of thinking (i.e., model) in the form of purposeful artifacts or tools that can be visually inspected and/or otherwise manipulated so that, when the tools or artifacts are tested, the adequacy of underlying conceptualizations also will be tested. These tools and artifacts can range from spreadsheets with graphs to other kinds of constructions whose mathematical "objects" might include, even for primary school children, not only counts and measures, but also composite units (i.e., units of units), coordinates (i.e., ordinal positions or locations in n-dimensional spaces), transformations or operators, rates, weights, or quantities that have both a magnitude and a direction (i.e., vectors)—as well as continuously changing quantities or accumulating quantities (English, Lesh, Riggs, & Sevis, in press; Lehrer, Kim, & Jones, 2011). In fact, one of the signature characteristics of modeling research, compared with much of the Piaget-inspired constructivist research with which it shares many common assumptions, has been its optimistic view of the possibilities of accelerating young children's conceptual developments.

A third design principle concerns variability and student authority in making self-assessments (Lesh, 2002). When problems are posed that conform to the first two principles, one likely result is variability in student solutions (Lehrer & Schauble, 2000, 2004). So, if this variability is to provide an opportunity for further mathematical developments, there is a need for activity structures in the classroom such as design postings or design reviews, where student inventions can be compared and contrasted, assessed, and revised. In fact, these forums for model review constitute a fourth design principle. It is important to emphasize function and form during design reviews, rather than simply adherence to previously determined canons. However, canonical solutions can be introduced as means of solving problems once they have been recognized by students as being important to address.

Finally, the tools and artifacts that students produce should be sharable (with other people) and reusable (beyond the specific situation in which it was developed). In other words, the models that students develop should represent generalizable and transferrable forms of knowledge. So, a byproduct of these principles is that modeling activities should make student thinking visible in ways that help teachers focus on "changing students' ways of thinking," rather than simply introducing one topic after another (Zawojewski, Chamberlin, Hjalmarson, & Lewis, 2008). This observation is consistent with the fact that many of the most effective methods of improving teaching focus on helping teachers become more insightful about their students' ways of thinking—especially ways of thinking about the most important "big ideas" that teachers are expected to teach (Lesh & Doerr, 1998; Lesh, Hamilton, & Kaput, 2007).

Entrée to Modeling

Figure 13.3 displays a solution to a problem encountered by first-second graders: What shape would serve as a good approximation to a fair game of "Mother, May I?" (Penner & Lehrer, 2000). In this children's game of tag, one player is a target (mother), and the goal of other players is to reach the target. But what is a fair initial starting configuration? Figuring out the answer to this question involves students in deciding on the nature of the problem and

Figure 13.3 The shape of fairness

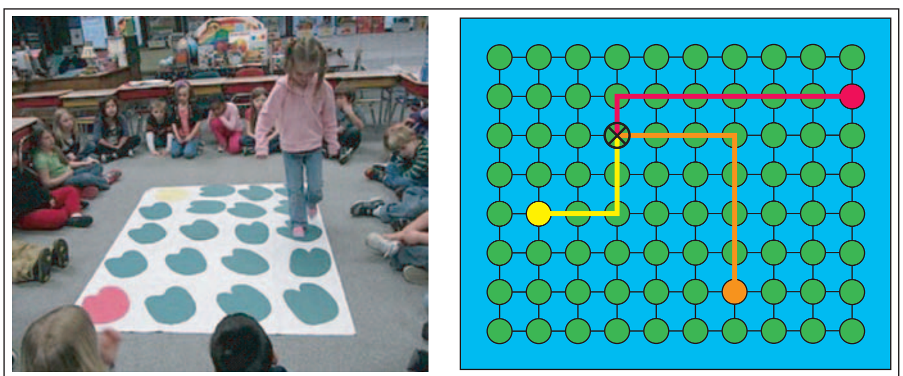
Source: Reprinted with permission of the National Council of Teachers of Mathematics.

developing spatial models as approximations of ideal starting conditions. As in other modeling problems, children's initial solutions were tested and found to be inadequate. For example, one initial solution was to literally place all players along a line with mother on a parallel line at the midpoint of the player line. The first insight was that this situation could be modeled geometrically with a line segment and point. The second was that the resulting configuration did not produce the same distance between each player and the target, mother. This discovery initiated a cycle of modeling in which different shapes were conjectured as good approximations (e.g., squares), only to reveal fatal flaws. The eventual consensus choice was a circle, but when students found a suitable circle painted on their playground, a new problem arose. How could they find the center, so that mother would be appropriately located? This new problem again initiated cycles of conjecture and revision, finally resolved by intersecting two rope diameters, as depicted in Figure 13.3. Thus, the modeling here involved the forms of inscription and notation previously referred to as tools for visualization, classroom talk featuring conjectures and refutations, and investigations of the shape of space, including attention to properties and measures that corresponded to different model-approximations of fair play.

Figure 13.4 shows a kindergarten classroom in which children's literature was used to provide contexts for model development activities, that is, activities in which the product that children need to produce includes an explicit model of the situation (English et al., in press). In this picture, the children are being introduced to a story about *Beauregard Frog* and the "proper hops" that all frogs must use to get from one lily pad to another in Sugar Swamp. The story describes why frogs in Sugar Swamp are allowed to jump horizontally or vertically only to adjacent lily pads. Beauregard's problem is that he wants to locate his "home lily pad" at a place that minimizes the sum of the distances to the three lily pads where his three best friends live. The problem provides opportunities for children to use numbers to refer to: (a) hops that are taken, (b) distances between lily pads, and (c) locations of lily pads. In fact, the problem involves a topic that mathematicians might call "locus of points" in analytic geometry. Many of the children in our studies noticed that: (a) the locus of points is a square (n) if the goal is to find the locations of all of the points which are a given number of hops from some point that is marked with an X, and (b) the locus of points is a straight line if the goal is to find the locations of all points that are equidistant from two given points.

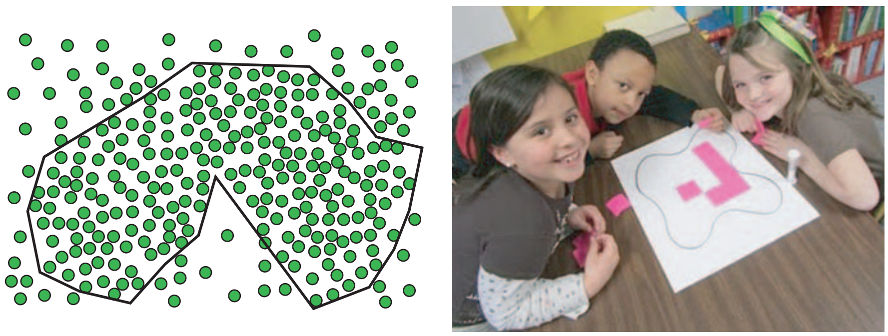
The solution also involved writing a "letter" (with teacher assistance) to Beauregard telling him how to solve his problem regardless where his three friends live. For our purposes, the main point was not to press the children for writing excellence, but instead to ensure that children understood that "someone else" wanted to know the procedure that they figured out. Moreover, the other person needed a procedure that would work for a variety of situations, a principle of generalization realized by making it clear to children that their procedure needed to be sharable and reusable.

Figure 13.5a shows another model development activity based on a story about a horse named Isabelle who loves to eat apples in the shade of apple trees. The children's task is to write a letter to Tom, Isabelle's owner, describing how, for a given orchard, the largest number of trees can be enclosed inside a fence of a given length, where the fence is a string of soda straws on a loop of string. The children's solution must take into account the fact that, each month, when Isabelle has eaten all of the apples in a given area, Tom must move the location of his fence to a new location where the trees



(a) Introducing the "Proper Hop" Problem (b) A Picture of Three Paths in Sugar Swamp

Figure 13.4 A problem about minimizing the lengths of paths



(a) Maximizing Trees inside a Fence (b) Maximizing Rugbug Homes in an Area

Figure 13.5 Two problems about relationships between perimeters and areas

are distributed differently. This problem involves relationships between perimeter and area-in-a-nonhomogeneous-space (where the apple trees are not equally distributed). Once again, the problem involves maximization and producing a sharable and reusable tool. Similarly, Figure 13.5b shows a model development activity based on a story about *Fussy Rugbugs* (whose homes are represented as colored post-it notes), and who insist that their rugs must be put together so they "just touch" but "don't overlap" inside given regions specified by a closed curve line.

Raising the Conceptual Ante With Modeling

Figure 13.6a shows the first page of a story about *Two-Headed Stickbugs.* The model development problem that accompanies this story involves two sizes of "stickbugs," one made using popsicle sticks, and the other using meter-long strips of wood. As a warm-up activity, the children work in groups of three, where each child has a meter-long stickbug, and the goal is to measure as many distances as possible in the playground in the schoolyard. The teacher records these distances by drawing and labeling arrows on a poster-size photograph of the schoolyard. Then, in the follow-up model-development the children again work in groups of three and use the popsicle-size stickbugs to create a miniaturized scale-model of the playground. The problem involves scaling-up and scaling-down, distances and lengths, and some kind of triangulation or coordinatization. It changes scale and modality of expression to allow students opportunities to make generalizations experientially. Figure 13.6b depicts another model-eliciting task involving scaling and modality, one where children develop scale model maps of the playground given photographs of the top-view of the most significant objects in the space. Children are challenged to consider distance and direction as well as ways of inscribing these relations.

(a) The First Page of a Stickbug Story (b) One Corner of a Playground

Figure 13.6 A problem about scaling, lengths, distances, and locations

Modeling Versus Problem Solving

Approximately every 10 years for the past 60 years, curriculum reform in the United States has gone through pendulum swings back and forth between: (a) emphasizing "basic facts and skills," and (b) emphasizing "problem solving." When basic skills are emphasized, the "things to be learned" are easily testable facts and rules, and, when problem solving is emphasized, the "things to be learned" seldom stray far from Polya's famous heuristics and strategies, which are often referred to as higher-order thinking skills. Models, in contrast, are not facts, and they are not skills, either. They are frameworks or metaphors for making sense of experiences. So by far the most important characteristic that distinguishes research on models and modeling from traditional research on problem solving is the recognition that—regardless of whether investigations focus on decision making by medical doctors, business leaders, chess players, or others in real-life decisionmakers—in virtually every field where learning scientists have investigated differences between ordinary and exceptionally productive people, it has become clear that exceptionally productive people not only *do* things differently, but they also *see* (or *interpret*) things differently (e.g., the research referred to previously about teacher noticing of student thinking). Furthermore, when problem solvers interpret situations, they do not simply engage models that are completely mathematical or logical in nature. Their interpretations also include feelings, values, and dispositions about engaging in this form of mathematical (and scientific) practice (e.g., Lehrer, Schauble, & Lucas, 2008).

IMPLICATIONS

Mathematical thinking is a specialized form of argument and inscription, but it has its genesis in the development of everyday capacities of pretense, possibility, conversation, and inscription. Development of mathematical literacy relies on the design of learning niches that support its continued evolution. Schooling provides an unparalleled opportunity to nurture mathematical thinking, because it is one of the few arenas where histories of learning can be systematically supported. This opportunity is founded on the material support of curriculum, the knowledge and practices of teachers, and continued development of knowledge about student thinking and learning in contexts where mathematical forms of argument and inscription take center stage. With this in mind, we suggest a few plausible directions for research in mathematics education.

First, we urge consideration of a broader scope of mathematical activity as worthy of research. Most studies focus on analysis at later grades or number concepts at earlier grades. Although we believe this research is productive and valuable, it ignores realms of mathematics that may well prove foundational for a mathematics education. For example, the Elkonin-Davydov approach to elementary mathematics education in Russia takes measurement, not "natural" numbers, as foundational. Hence, in this program children's early mathematical experiences are oriented toward quantity, not count (Dougherty, 2008.). Other possibilities suggest themselves, such as early and prolonged emphasis on space and geometry, as well as consideration of the roles of modeling and design in the formation of mathematical expression and epistemology. In addition to reconsidering foundational experiences in mathematics education, research might profit by a broader embrace of mathematical activity in related domains, such as engineering and natural sciences (e.g., Katehi, Pearson, & Feder, 2009). For example, ideas of chance and uncertainty characteristic of a statistical reasoning are not the exclusive province of any discipline and learning about these ideas might be better supported at the junction of several of them (e.g., Konold & Lehrer, 2008).

Second, in keeping with our focus on epistemic practices, we noticed that few studies carefully consider the interplay between these practices and the generation of mathematical knowledge, and even fewer trace the development of these practices over prolonged periods of time. We frequently found descriptions of episodes of learning involving practices of argument and inscription, but it was difficult to trace from these accounts how the knowledge apparently developed by students in any moment in time later served as resources for their construction of other elements of a mathematical system. For example, if students defined a mathematical object at one point in time, how did this definition later play out in later conjecture and proof? A related issue is the need for investigation and analysis of multiple levels of organization as learners develop a mathematical system. For example, Saxe and his colleagues (e.g., Saxe & Esmonde, 2005) call for deliberate attention to three levels of individual activity that are linked by collective participation in practices of mathematical argument and inscription: microgenetic purposing of forms to serve functions in ongoing activity (e.g., dragging in a dynamic geometry microworld), ontogenetic recapitulation or change in the relations between forms and function (e.g., transiting between random dragging to purposeful search for invariants), and sociogenetic uptake and alteration of forms by collectives over time (e.g., establishing a classroom culture that privileges conjectures based on demonstrations of conjectured relationships via dragging).

Third, research on models and modeling suggests the need to reformulate much of what is currently considered as problem-based education. As we have illustrated, model development can be designed to focus on concepts that are considered “big ideas” in mathematics or science education. And, because model development activities are activities in which models, which often are expressed as purposeful tools, are the products that problem solvers produce, model development activities tend to be thought-revealing activities in which important aspects of students’ interpretation systems (Lesh et al., 2003) and the processes that lead to conceptual adaptations often can be observed directly (Lesh & Doerr, 2011). Consequently, research on models and modeling has led not only to optimism about the abilities of children to create important mathematical models, but also to fundamentally new ways of thinking about the nature of problem solving, problem solvers, and problem-solving processes (Kelly & Lesh, 2000). These include:

- Traditionally, problem solving has been characterized as a process of (a) getting from givens to goals when the path is not obvious, and (b) putting together previously learned concepts, facts, and skills in some new (to the problem solver) way to solve problems at hand. When attention shifts toward modeling, problematic situations are goal directed activities in which adaptations need to be made in existing ways of thinking about givens, goals, and possible solution steps. Modeling is a way of creating mathematics (Lesh & Caylor, 2007), and modeling and concept development are expected to be highly interdependent and mutually supportive activities.
- Modeling situates mathematical processes in inscriptions, visualizations, and analogies. It makes explicit the instrumented, material conditionality of mathematical cognition.
- Traditionally, problem solving in mathematics education has focused on individual students working without tools on textbook word problems. But, research on models and modeling tends to focus on simulations of “real-life” situations, and problem solvers often are diverse teams of students, each of whom has access to a variety of specialized technical tools and resources. Hence, capabilities that become important include modularization, communication, explanation, and documentation, as well as planning, monitoring, and assessment. All of these tend to be overlooked in the traditional mathematics education problem solving literature.

In closing, we suggest that understanding the development of mathematical thinking is an epistemic endeavor that demands coordinated attention to the design of learning environments and to the forms of knowledge and practice that are cultivated in these environments. Perhaps the most critical outcome, and currently the least well understood, is the propensity of students so engaged to develop disciplinary dispositions for the wide range of activity that can be called mathematical.

REFERENCES

Abrahamson, D., & Wilensky, U. (2007). Learning axes and bridging tools in a technology-based design for statistics. *International Journal of Computers for Mathematical Learning, 12,* 23–55.

Amsel, E., & Smalley, J. D. (2001). Beyond really and truly: Children’s counterfactual thinking about pretend and possible worlds. In P. Mitchell & K. J. Riggs (Eds.), *Children’s reasoning and the mind* (pp. 121–147). Hove, UK: Taylor & Francis.

Anderson, J. R., & Schunn, C. D. (2000). Implications of the ACT-R learning theory: No magic bullets. In R. Glaser (Ed.), *Advances in instructional psychology. Educational design and cognitive science* (Vol. 5, pp. 1–33). Mahwah, NJ: Erlbaum.

Anderson, R. C., Chinn, C., Chang, J., Waggoner, M., & Yi, H. (1997). On the logical integrity of children’s arguments. *Cognition and Instruction, 15* (2), 135–167.

Arcavi, A., & Hadas, N. (2000). Computer mediated learning: An example of an approach. *International Journal of Computers for Mathematical Learning, 5,* 25–45.

Auslander, J. (2008). On the roles of proof in mathematics. In B. Gold & R. A. Simons (Eds.), *Proof and other dilemmas: Mathematics and philosophy* (pp. 61–77). Washington, DC: Mathematical Association of America.

Baccaglini-Frank, A. & Mariotti, M. A. (2010). Generating conjectures in dynamic geometry: The maintaining dragging model. *International Journal of Computers for Mathematical Learning, 15,* 225–253.

Ball, D. L. (1993). With an eye on the mathematical horizon: Dilemmas of teaching elementary school mathematics. *Elementary School Journal, 4,* 373–397.

Ball, D. L., & Bass, H. (2000). Making believe: The collective construction of public mathematical knowledge in the elementary classroom. In D. Phillips (Ed.), *Yearbook of the national society for the study of education, constructivism in education* (pp. 193–224). Chicago, IL: University of Chicago Press.

Ball, D. L., & Bass, H. (2003). Making mathematics reasonable in school. In J. Kilpatrick, W. G. Martin, & D. Schifter (Eds.), *A research companion to principles and standards for school mathematics* (pp. 27–44). Reston, VA: National Council of Teachers of Mathematics.

Barker, R. G., & Wright, H. F. (1954). *Midwest and its children: The psychological ecology of an American town.* Evanston, IL: Row, Peterson.

Benson, D. C. (1999). *The moment of proof.* Oxford, UK: Oxford University Press.

Berlinski, D. (2000). *The advent of the algorithm.* New York, NY: Harcourt.

Blum, W., Galbraith, P. L., Henn, H.-W., & Niss, M (2007). *Modelling and applications in mathematics education.* The 14th ICMI study. New York, NY: Springer.

Boaler, J. (2002a). The development of disciplinary relationships: Knowledge, practice and identity in mathematics classrooms. *For the Learning of Mathematics, 22,* 42–47.

Boaler, J. (2002b). *Experiencing school mathematics. Traditional and reform approaches to teaching and their impact on student learning.* Mahwah, NJ: Erlbaum.

Boaler, J., & Staples, M. (2008). Creating mathematical futures through an equitable teaching approach: The case of Railside school. *Teachers College Record, 110*(3), 608–645.

Brizuela, B. (1997). Inventions and conventions: A story about capital numbers. *For the Learning of Mathematics, 17,* 2–6.

Brown, A., & Campione, J. (1996). Psychological theory and the design of innovative learning environments.: On procedures, principles, and systems. In L. Schauble & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. 289–335). Mahwah, NJ: Erlbaum.

Chapin, S. H., O'Connor, C., & Anderson, N. C. (2003). *Classroom discussions. Using math talk to help students learn.* Sausalito, CA: Math Solutions.

Chazan, D. (1993). High school geometry students' justification for their views of empirical evidence and mathematical proof. *Educational Studies in Mathematics, 24,* 359–387.

Choppin, J. (2011). The impact of professional noticing on teachers' adaptations of challenging tasks. *Mathematical Thinking and Learning, 13,* 175–197.

Cobb, P. (2001). Supporting the improvement of learning and teaching in social and institutional context. In S. Carver & D. Klahr (Eds.), *Cognition and instruction: Twenty-five years of progress* (pp. 455–478). Mahwah, NJ: Erlbaum.

Cobb, P., Gravemeijer, K., Yackel, E., McClain, K., & Whitenack, J. (1997). Mathematizing and symbolizing: The emergence of chains of signification in one first-grade classroom. In D. Kirshner & J. A. Whitson (Eds.), *Situated cognition: Social, semiotic, and psychological perspectives* (pp. 151–233). Mahwah, NJ: Erlbaum.

Cobb, P., Wood, T., Yackel, E., & McNeal, B. (1992). Characteristics of classroom mathematics traditions: An interactional analysis. *American Education Research Journal, 29*(3), 573–604.

Cobb, P., Yackel, E., & Wood, T. (1988). Curriculum and teacher development: Psychological and anthropological perspectives. In E. Fennema, T. P. Carpenter, & S. J. Lamon (Eds.), *Integrating research on teaching and learning mathematics* (pp. 92–121). Madison: University of Wisconsin.

Coe, R., & Ruthven, K. (1994). Proof practices and constructs of advanced mathematics students. *British Educational Research Journal, 20,* 41–53.

Cohen, S. (1985). The development of constraints on symbol meaning structure in notation: Evidence from production, interpretation, and forced-choice judgments. *Child Development, 56,* 177–195.

Crosby, A. W. (1997). *The measure of reality.* Cambridge, UK: Cambridge University Press.

Danish, J., & Enyedy, N. (2007). Remember, we have to do all the parts of the rose: Negotiated representational mediators in a K–1 science classroom. *Science Education, 91,* 1–35.

Davis, P. J., & Hersh, R. (1981). *The mathematical experience.* Boston, MA: Houghton Mifflin.

DeLoache, J. S. (1987). Rapid change in symbolic functioning of young children. *Science, 238,* 1556–1557.

DeLoache, J. S. (1989). Young children's understanding of the correspondence between a scale model and a larger space. *Cognitive Development, 4,* 121–139.

DeLoache, J. S. (1995). Current understanding and use of symbols: The model model. *Current Directions in Psychological Science, 4,* 109–113.

Detlefsen, M. (2008). Proof: Its nature and significance. In B. Gold & R. A. Simons (Eds.), *Proof and other dilemmas: Mathematics and philosophy* (pp. 3–32). Washington, DC: Mathematical Association of America.

de Villiers, M. (1998). An alternative approach to proof in dynamic geometry. In R. Lehrer & D. Chazan (Eds.), *Designing learning environments for developing understanding of geometry and space* (pp. 369–393). Mahwah, NJ: Erlbaum.

Dias, M. G., & Harris, P. L. (1988). The effect of make-believe play on deductive reasoning. *British Journal of Developmental Psychology, 6,* 207–221.

Dias, M. G., & Harris, P. L. (1990). The influence of the imagination on reasoning by young children. *British Journal of Developmental Psychology, 8,* 305–318.

diSessa, A. (1995). Epistemology and systems design. In A. diSessa, C. Hoyles, R. Noss, & L. D. Edwards (Eds.), *Computers and exploratory learning* (pp. 15–29). Berlin, Germany: Springer-Verlag.

diSessa, A. (2000). *Changing minds: Computers, learning, and literacy.* Cambridge, MA: MIT Press.

diSessa, A. (2004). Metarepresentation: Native competence and targets for instruction. *Cognition and Instruction, 22,* 293–331.

diSessa, A. A. (2002). Students' criteria for representational adequacy. In K. Gravemeijer, R. Lehrer, B. van Oers, & L. Verschaffel (Eds.), *Symbolizing, modeling and tool use in mathematics education.* Dortrecht, The Netherlands: Kluwer.

diSessa, A., Hammer, D., Sherin, B., & Kolpakowski, T. (1991). Inventing graphing: Metarepresentational expertise in children. *Journal of Mathematical Behavior, 10,* 117–160.

Dougherty, B. J. (2008). Measure up: A quantitative view of early algebra. In Kaput, J. J., Carraher, D. W., & Blanton, M. L. (Eds.), *Algebra in the early grades* (pp. 389–412). Mahwah, NJ: Erlbaum.

Drew, P., & Heritage, J. E. (1992). *Talk at work.* Cambridge, UK: Cambridge University Press.

Edwards, L. D. (1999). Odds and evens: Mathematical reasoning and informal proof. *Journal of Mathematical Behavior, 17,* 489–504.

Ellis, A. (2011). Generalizing-promoting actions: How classroom collaborations can support students' mathematical generalizations. *Journal for Research in Mathematics Education, 42,* 308–345.

Engle, R. A., & Conant, F. R. (2002). Guiding principles for fostering productive disciplinary engagement. *Cognition and Instruction, 20*(4), 399–483.

English, L. Lesh, R., Riggs, C., & Sevis, S. (in press). Problem solving in the primary school (K-2). In M. Santos (Ed), *Problem solving in mathematics education.* New York, NY: Sense.

Forman, E. A. (2003). A sociocultural approach to mathematics reform: Speaking, inscribing, and doing mathematics within communities of practice. In J. Kilpatrick, G. Martin, & D. Shifter (Eds.), *A research companion to the Standards and Principles* (pp. 333–352). Reston, VA: National Council of Teachers of Mathematics.

Forman, E. A., Larreamendy-Joerns, J., Stein, M. K., & Brown, C. A. (1998). "You're going to want to find out which and prove it": Collective argumentation in a mathematics classroom. *Learning and Instruction, 8,* 527–548.

Fosnot, C. T., & Jacobs, B. (2009). Young mathematicians at work. In D. A. Stylianou, M. L. Blanton, & E. J. Knuth (Eds.), *Teaching and learning proof across the grades. A K-16 perspective* (pp. 102–119). New York, NY: Routledge.

Freudenthal, H. (1973). *Mathematics as an educational task.* Dordrecht, The Netherlands: Reidel.

Freudenthal, H. (1991). Revisiting mathematical education: China lectures. Hingham, MA: Kluwer Academic Publishers.

Garfinkel, H., & Sacks, H. (1970). On formal structures of practical action. In J. McKinney & E. Tiryakin (Eds.), *Theoretical sociology: Perspectives and development* (pp. 337–366). New York, NY: Appleton-Century-Crofts.

Gee, J. P. (1997). Thinking, learning, and reading: The situated sociocultural mind. In D. Kirshner & J. A. Whitson (Eds.), *Situated cognition: Social, semiotic, and psychological perspectives* (pp. 235–259). Mahwah, NJ: Erlbaum.

Gee, J. P. (in press). Critical discourse analysis. In R. Beach, J. Green, M. Kamil, & T. Shanahan (Eds.), *Multidisciplinary perspectives on literacy research.* Cresskill, NJ: Hampton Press.

Gentner, D. (1983). Structure-mapping: Atheoretical framework for analogy. *Cognitive Science, 7,* 155–170.

Gentner, D., & Loewenstein, J. (2002). Relational language and relational thought. In E. Amsel & J. P. Byrnes (Eds.), *Language, literacy, and cognitive development. The development and consequences of symbolic communication* (pp. 87–120). Mahwah, NJ: Erlbaum.

Gentner, D., & Toupin, C. (1986). Systematicity and surface similarity in the development of analogy. *Cognitive Science, 10*, 277–300.

Glasersfeld, E. (1995). Radical constructivism: A way of knowing and learning. London: Falmer.

Giere, R. N. (1992). *Cognitive models of science.* Minneapolis: University of Minnesota Press.

Goldenberg, E. P., Cuoco, A. A., & Mark, J. (1998). A role for geometry in general education. In R. Lehrer & D. Chazan (Eds.), *Designing learning environments for developing understanding of geometry and space* (pp. 3–44). Mahwah, NJ: Erlbaum.

Goodman, N. (1976). *Languages of art.* Indianapolis, IN: Hackett.

Goodnow, J. (1977). *Children's drawings.* Cambridge, MA: Harvard University Press.

Goodwin, C. (1994). Professional vision. *American Anthropologist, 96*(3), 606–633.

Goodwin, C. (1996). Transparent vision. In E. Ochs, E. A. Schegloff, & S. A. Thompson (Eds.), *Interaction and grammar* (pp. 370–404). Cambridge, UK: Cambridge University Press.

Goodwin, C. (2000). Practices of color classification. *Mind, culture, and activity, 7*(1 & 2), 19–36.

Gravemeijer, K. (1999). How emergent models may foster the constitution of formal mathematics. *Mathematical Thinking and Learning,* 155–177.

Gravemeijer, K., Cobb, P., Bowers, J., & Whitenack, J. (2000). Symbolizing, modeling, and instructional design. In P. Cobb, E. Yackel, & K. McClain (Eds.), *Symbolizing and communicating in mathematics classrooms* (pp. 225–273). Mahwah, NJ: Erlbaum.

Greeno, J. G. (1998). The situativity of knowing, learning, and research. *American Psychologist, 53,* 5–26.

Gresalfi, M. S. (2009). Taking up opportunities to learn: Constructing dispositions in mathematics classrooms. *Journal of the Learning Sciences, 18*(3), 327–369.

Hall, R. (1990). *Making mathematics on paper: Constructing representations of stories about related linear functions*. Unpublished doctoral dissertation, University of California at Irvine.

Hall, R. (1996). Representation as shared activity: Situated cognition and Dewey's cartography of experience. *The Journal of the Learning Sciences, 5*(3), 209–238.

Hall, R. (1999). The organization and development of discursive practices for "having a theory." *Discourse Processes, 27,* 187–218.

Hall, R., Stevens, R., & Torralba, T. (2002). Disrupting representational infrastructure in conversations across disciplines. *Mind, Culture, and Activity, 9*(3), 179–210.

Halliday, M. A. K. (1978). Sociolinguistics aspects of mathematical education. In M. Halliday (Ed.), *Language as social semiotic: The social interpretation of language and meaning* (pp. 195–204). London, UK: University Park Press.

Hanna, G. (1990). Some pedagogical aspects of proof. *Interchange, 21*(1), 6–13.

Hanna, G. (1991). Mathematical proof. In D. Tall (Ed.), *Advanced mathematical thinking* (pp. 54–61). Dordrecht, The Netherlands: Kluwer.

Hanna, G. (1995). Challenges to the importance of proof. *For the Learning of mathematics, 15,* 42–49.

Harel, G. (1998). *Greek versus modern mathematical thought and the role of Aristotelian causality in the mathematics of the Renaissance: Sources for understanding epistemological obstacles in college students' conceptions of proof*. Plenary talk given at the International Linear Algebra Society Conference, Madison, WI.

Harel, G. (2008). What is mathematics? A pedagogical answer to a philosophical question. In R. B. Gold & R. Simons (Eds.), *Proofs and other dilemmas: Mathematics and philosophy* (pp. 265–290). Washington, DC: Mathematical Association of America.

Harel, G., & Sowder, L. (1998). Students' proof schemes: Results from exploratory studies. In A. Schoenfeld, J. Kaput & E. Dubinsky (Eds.), *Research on collegiate mathematics education III* (pp. 234–283). Providence, RI: American Mathematical Society.

Harris, P. J., & Leevers, H. J. (2001). Reasoning from false premises. In P. Mitchell & K. J. Riggs (Eds.), *Children's reasoning and the mind* (pp. 67–86). Oxford, UK: Psychology Press, Taylor & Francis.

Haverty, L. A., Koedinger, K. R., Klahr, D., & Alibali, M. W. (2000). Solving inductive reasoning problems in mathematics: Not-so-trivial pursuit. *Cognitive Science, 24,* 249–298.

Hawkins, J., Pea, R. D., Glick, J., & Scribner, S. (1984). Merds that laugh don't like mushrooms. *Developmental Psychology, 20,* 584–594.

Healy, L., & Hoyles, C. (2000). A study of proof conceptions in algebra. *Journal for Research in Mathematics Education, 31,* 396–428.

Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*(5), 524–549.

Herbst, P. (2002). Understanding the work of the teacher getting students to prove. *Journal of Research in Mathematics Education, 33,* 176–203.

Herbst, P. (2005). Knowing about "equal area" while proving a claim about equal areas. *Recherches en Didactique des Mathématiques, 25*(1), 11–56.

Herbst, P., & Balacheff, N. (2009). Proving and knowing in public. The nature of proof in the classroom. In D. A. Stylianou, M. L. Blanton, & E. J. Knuth (Eds.), *Teaching and learning proof across the grades. A K-16 perspective* (pp. 40–63). New York, NY: Routledge.

Herbst, P., & Brach, C. (2006). Proving and doing proof in high school geometry classes: What is going on for students? *Cognition and Instruction, 24,* 73–122.

Herbst, P., Nachlieli, T., & Chazan, D. (2011). Studying the practical rationality of mathematics teaching: What goes into "installing" a theorem in geometry? *Cognition and Instruction, 29*(2), 218–255.

Herrenkohl, L. R., & Guerra, M. R. (1998). Participant structures, scientific discourse, and student engagement in fourth grade. *Cognition and Instruction, 16,* 431–473.

Hersh, R. (1993). Proving is convincing and explaining. *Educational Studies in Mathematics, 24*(4), 389–399.

Hershkowitz, R., & Schwarz, B. B. (1999). Reflective processes in a mathematics classroom with a rich learning environment. *Cognition and Instruction, 17,* 65–91.

Hesse, M. B. (1962). *Forces and fields.* Totowa, NJ: Littlefield, Adams.

Hestenes, D. (1992). Modeling games in the Newtonian world. *American Journal of Physics, 60,* 440–454.

Hill, H. C., Blunk, M. L., Charalambos, C. Y., Lewis, J. M., Phelps, G. C., Sleep, L., & Ball, D. L. (2008). Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study. *Cognition and Instruction, 26*(4), 430–511.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42,* 371–406.

Hill, H. C., Schilling, S. C., & Ball, D. L. (2004). Developing measures of teachers' mathematics knowledge for teaching. *Elementary School Journal, 105,* 11–30.

Hofstadter, D. (1979). *Godel, Escher, Bach: An eternal golden braid.* New York, NY: Basic Books.

Holland, J. H. (1995). *Hidden order: How adaptation builds complexity.* New York, NY: Addison-Wesley.

Holland, J. H. (1998). *Emergence: From chaos to order.* Reading, MA: Addison-Wesley.

Hoyles, C. (1997). The curricular shaping of students' approaches to proof. *For the Learning of Mathematics, 17,* 7–16.

Hufferd-Ackles, K., Fuson, K. C., & Sherin, M. G. (2004). Describing levels and components of a math-talk learning community. *Journal for Research in Mathematics Education, 35*(2), 81–116.

Inhelder, B., & Piaget, J. (1958). *The growth of logical thinking from childhood to adolescence.* New York, NY: Basic Books.

Izsak, A. (2000). Inscribing the winch: Mechanisms by which students develop knowledge structures for representing the physical world with algebra. *The Journal of the Learning Sciences, 9*(1), 31–74.

Jackiw, N. (1995). *The geometer's sketchpad.* Berkeley, CA: Key Curriculum Press.

Jacobs, V., Lamb, L. L., & Philipp, R. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education, 41,* 169–202.

Jacobson, C., & Lehrer, R. (2000). Teacher appropriation and student learning of geometry through design. *Journal for Research in Mathematics Education, 31,* 71–88.

Jorgensen, J. C., & Falmagne, R. J. (1992). Aspects of the meaning of if . . . then for older preschoolers: Hypotheticality, entailment, and suppositional processes. *Cognitive Development, 7,* 189–212.

Kaiser, D. (2000). Stick-figure realism: Conventions, reification, and the persistence of Feynman diagrams, 1948–1964. *Representations, 70,* 49–86.

Kaiser, G., Blum, W., Ferri, R. B., & Stillman, G., (2011). Trends in teaching and learning of mathematical modeling: International perspectives on the teaching and learning of mathematical modeling 1. Springer Verlag.

Kaput, J. (1991). Notations and representations as mediators of constructive processes. In E. von Glasersfeld (Ed.), *Radical constructivism in mathematics education* (pp. 53–74). Dordrecht, The Netherlands: Kluwer.

Kaput, J. (1992). Technology and mathematics education. In D. A. Grouws (Ed.), *Research on mathematics teaching and learning* (pp. 515–556). New York, NY: Macmillan.

Kaput, J., & Shaffer, D. (2002). On the development of human representational competence from an evolutionary point of view. In K. Gravemeijer, R. Lehrer, B. Van Oers, & L. Verschaffel (Eds.), *Symbolizing, modeling, and tool use in mathematics education* (pp. 269–286). Dordrecht, The Netherlands: Kluwer.

Karmiloff-Smith, A. (1979). Micro- and macrodevelopmental changes in language acquisition and other representational systems. *Cognitive Science, 3,* 91–118.

Karmiloff-Smith, A. (1992). *Beyond modularity.* Cambridge, MA: MIT Press.

Katehi, L., Pearson, G., & Feder, M. (2009). *Engineering in K-12 education.* Washington, DC: National Academies Press.

Kelly, A. E., & Lesh, R. A. (Eds.). (2000). *Handbook of research design in mathematics and science education.* Mahwah, NJ: Erlbaum.

Kemeny, V. (2001). *Discursive construction of mathematical meaning: A study of teaching mathematics through conversation in the primary grades*. Doctoral dissertation, University of Wisconsin, Madison.

Kline, M. (1980). *Mathematics: The loss of certainty.* Oxford, UK: Oxford University Press.

Knorr Cetina, K. (1999). *Epistemic cultures: How the sciences make knowledge.* Cambridge, MA: Harvard University Press.

Knuth, E. (2002). Teacher's conceptions of proof in the context of secondary school mathematics. *Journal of Mathematics Teacher Education, 5*(1), 61–88.

Knuth, E. J., Choppin, E. J., & Bieda, K. (2009). Middle school students' production of mathematical justifications. In D. A. Stylianou, M. L. Blanton, & E. J. Knuth (Eds.), *Teaching and learning proof across the grades. A K-16 perspective* (pp. 153–170). New York, NY: Routledge.

Koedinger, K. R. (1998). Conjecturing and argumentation in high school geometry students. In R. Lehrer & D. Chazan (Eds.), *Designing learning environments for developing understanding of geometry and space* (pp. 319–347). Mahwah, NJ: Erlbaum.

Koedinger, K. R., & Anderson, J. R. (1990). Abstract planning and perceptual chunks: Elements of expertise in geometry. *Cognitive Science, 14,* 511–550.

Konold, C., & Lehrer, R. (2008). Technology and mathematics education: An essay in honor of Jim Kaput. In L. D. English (Ed.), *Handbook of international research in mathematics education* (2nd ed). Philadelphia, PA: Taylor & Francis.

Konold, C., & Miller, C. S. (2005). *Tinkerplots: Dynamic data exploration.* Emeryville, CA: Key Curriculum Press.

Kotovsky, L., & Gentner, D. (1996). Comparison and categorization in the development of relational similarity. *Child Development, 67,* 2797–2822.

Krummerheuer, G. (1995). The ethnography of argumentation. In P. Cobb & H. Bauersfeld (Eds.), *The emergence of mathematical meaning* (pp. 229–269). Mahwah, NJ: Erlbaum.

Krummerheuer, G. (1998). Formats of argumentation in the mathematics classroom. In H. Steinbring, M. G. Bartolini Bussi, & A. Sierpinska (Eds.), *Language and communication in the mathematics classroom* (pp. 223–234). Reston, VA: National Council of Teachers of Mathematics.

Kuhn, D. (1977). Conditional reasoning in children. *Developmental Psychology, 13,* 342–353.

Kuhn, D. (1989). Children and adults as intuitive scientists. *Psychological Review, 96,* 674–689.

Kuhn, D. (1991). *The skills of argument.* Cambridge, UK: Cambridge University Press.

Kuhn, D. (1992). Thinking as argument. *Harvard Educational Review, 62,* 155–178.

Kuhn, D. (2001). How do people know? *Psychological Science, 12*(1), 1–8.

Kuhn, D., Amsel, E., & O'Loughlin, M. (1988). *The development of scientific thinking skills.* New York, NY: Academic Press.

Kuhn, D., Shaw, V., & Felton, M. (1997). Effects of dyadic instruction on argumentative reasoning. *Cognition and Instruction, 15,* 287–315.

Laborde, C., & Laborde, J. M. (1991). Problem solving in geometry: From microworlds to intelligent computer environments. In J. P. Ponte, J. F. Matos, J. M. Matos, & D. Fernandes (Eds.), *Mathematical problem solving and new information technologies* (pp. 177–192). NATO AS1 Series F, 89.

Lakatos, I. (1976). *Proofs and refutations.* Cambridge, UK: Cambridge University Press.

Lakoff, G., & Nunez, R. E. (1997). The metaphorical structure of mathematics: Sketching out cognitive foundations for a mind based mathematics. In L. D. English (Ed.), *Mathematical reasoning. Analogies, metaphors, and images* (pp. 21–89). Mahwah, NJ: Erlbaum.

Lakoff, G., & Nunez, R. E. (2000). *Where mathematics comes from.* New York, NY: Basic Books.

Lampert, M. (2001). *Teaching problems and the problems of teaching.* New Haven, CT: Yale University Press.

Lampert, M., Rittenhouse, P., & Crumbaugh, C. (1996). Agreeing to disagree: Developing sociable mathematical discourse. In D. Olson & N. Torrance (Eds.), *The handbook of education and human development* (pp. 731–764). Cambridge, MA: Blackwell.

Larsen, S. & Zandieh, M. (2008). Proofs and refutations in the undergraduate mathematics classroom. *Educational Studies in Mathematics, 67,* 205–216.

Latour, B. (1986). Visualization and cognition: Thinking with eyes and hands. *Knowledge and society: Studies in the sociology of culture past and present, 6,* 1–40.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society.* Cambridge, MA: Harvard University Press.

Latour, B. (1990). Drawing things together. In M. Lynch & S. Woolgar (Eds.), *Representation in scientific practice* (pp. 19–68). Cambridge, MA: MIT Press.

Lee, K., & Karmiloff-Smith, A. (1996). Children as notators: The development of external symbol use. In E. C. Carterette & M. P. Friedman (Eds.), *Handbook of perception, Vol 13. Perceptual and cognitive development* (pp. 185–211). New York, NY: Academic Press.

Lee, K., Karmiloff-Smith, A., Cameron, C. A., & Dodsworth, P. (1998). Notational adaptation in children. *Canadian Journal of Behavioural Science, 30,* 159–171.

Lehrer, R. (2002). Developing understanding of measurement. In J. Kilpatrick, G. Martin, & D. Schifter (Eds.), *A research companion to the Standards and Principles.* Reston, VA: National Council of Teachers of Mathematics.

Lehrer, R., Jacobson, C., Kemeny, V., & Strom, D. (1999). Building on children's intuitions to develop mathematical understanding of space. In E. Fennema & T. A. Romberg (Eds.), *Mathematics classrooms that promote understanding* (pp. 63–87). Mahwah, NJ: Erlbaum.

Lehrer, R., Jacobson, C., Thoyre, G., Kemeny, V., Strom, D., Horvath, J., . . . Koehler, M. (1998). Developing understanding of geometry and space in the primary grades. In R. Lehrer & D. Chazan (Eds.), *Designing learning environments for developing understanding of geometry and space* (pp. 169–200). Mahwah, NJ: Erlbaum.

Lehrer, R., Kemeny, V., & Gance, S. (1996, April). *Children model the structure of space: From cereal boxes to epistemology*. In Carol Kehr Tittle (Chair), *Evaluating Mathematics and Science Reform in School Classrooms: The Role of Theories in Frameworks for Evaluation.* Symposium conducted at American Educational Research Association, New York, NY.

Lehrer, R., Kim, M. J., & Jones, S. (2011). Developing conceptions of statistics by designing measures of distribution. *International Journal on Mathematics Education* (ZDM), *43*(5), 723–736.

Lehrer, R., Kim, M., & Schauble, L. (2007). Supporting the development of conceptions of statistics by engaging students in modeling and measuring variability. *International Journal of Computers for Mathematics Learning, 12,* 195–216.

Lehrer, R., & Pritchard, C. (2002). Symbolizing space into being. In K. Gravemeijer, R. Lehrer, B. Van Oers, & L. Verschaffel (Eds.), *Symbolizing, modeling, and tool use in mathematics education.* Dordrecht, The Netherlands: Kluwer Academic Press.

Lehrer, R., & Schauble, L. (2000). Modeling in mathematics and science. In R. Glaser (Ed.), *Advances in Instructional Psychology* (pp. 101–159). Mahwah, NJ: Erlbaum.

Lehrer, R., & Schauble, L. (2002). Symbolic communication in mathematics and science: Co-constituting inscription and thought. In E. Amsel & J. Byrnes (Eds.), *The development of symbolic communication* (pp. 167–192). Mahwah, NJ: Erlbaum.

Lehrer, R., & Schauble, L. (2004). Modeling natural variation through distribution. *American Educational Research Journal, 41*(3), 635–679.

Lehrer, R., & Schauble, L. (2005). Developing modeling and argument in elementary grades. In T. A. Romberg, T. P. Carpenter, & F. Dremock (Eds.) *Understanding mathematics and science matters* (pp. 29–53). Mahwah, NJ: Erlbaum.

Lehrer, R., & Schauble, L. (2006). Cultivating model-based reasoning in science education. In R. Keith Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 371–387). Cambridge, UK: Cambridge University Press.

Lehrer, R., & Schauble, L. (2007). A developmental approach for supporting the epistemology of modeling. In W. Blum, P. L. Galbraith, H.-W. Henn, & M. Niss (Eds.), *Modeling and applications in mathematics education* (pp. 153–160). New York, NY: Springer.

Lehrer, R., Schauble, L., Carpenter, S., & Penner, D. E. (2000). The inter-related development of inscriptions and conceptual understanding. In P. Cobb, E. Yackel, & K. McClain (Eds.), *Symbolizing and communicating in mathematics classrooms: Perspectives on discourse, tools, and instructional design* (pp. 325–360). Mahwah, NJ: Erlbaum.

Lehrer, R., Schauble, L., & Lucas, D. (2008). Supporting development of the epistemology of inquiry. *Cognitive Development, 24,* 512–529.

Lehrer, R., Strom, D., & Confrey, J. (2002). Grounding metaphors and inscriptional resonance: Children's emerging understanding of mathematical similarity. *Cognition and Instruction, 20,* 359–398.

Leinhardt, G., & Schwarz, B. B. (1997). Seeing the problem: An explanation from Polya. *Cognition and Instruction, 15,* 395–434.

Lesh, R. (2002). Research design in mathematics education: Focusing on design experiments. In L. English (Ed.), *The international handbook of research design in mathematics education* (pp. 241–287). Hillsdale, NJ: Erlbaum.

Lesh, R. & Carmona, G. (2003). Piagetian conceptual systems and models for mathematizing everyday experiences. In R. Lesh & H. M. Doerr (Eds.) *Beyond Constructivism: Models and Modeling Perspectives on Mathematics Problem Solving, Learning, and Teaching* (pp. 71–96). Mahwah, NJ: Erlbaum.

Lesh, R., & Caylor, E. (2007). Modeling as application vs. modeling as a way to create mathematics. *International Journal of Computers for Mathematical Learning*. *12,* 173–194.

Lesh, R., & Doerr, H. (1998). Symbolizing, communicating, and mathematizing: Key components of models and modeling. In P. Cobb & E. Yackel (Eds.), *Symbolizing and communicating in mathematics classrooms* (pp. 361–383). Mahwah, NJ: Erlbaum.

Lesh, R. A., & Doerr, H. M. (2003). Beyond constructivism: models and modeling perspectives on mathematics problem solving, learning, and teaching. Mahwah, NJ: Lawrence Erlbaum.

Lesh, R., & Doerr, H. (2011), Alternatives to trajectories and pathways to describe development in modeling and problem solving. In R. Borromeo-Ferri (Ed.), *Teaching mathematical modeling & applications.* New York, NY: Springer.

Lesh, R., Doerr, H., Carmona, G., & Hjalmarson, M. (2003). Beyond constructivism. *Mathematical Thinking and Learning, 5*(2–3), 211–233.

Lesh, R., Hamilton, E., & Kaput, J. (Eds.) (2007). *Foundations for the future in mathematics education.* Mahwah, NJ: Erlbaum.

Lesh, R., Hoover, M., Hole, B., Kelly, A., & Post, T. (2000). Principles for developing thought-revealing activities. In A. Kelly & R. Lesh (Eds.), *The handbook of research design in mathematics and science education.* Hillsdale, NJ: Erlbaum.

Lesh, R., & Lamon, S. (1992) Assessing Authentic Mathematical Performance. Washington, DC: American Association for the Advancement of Sciences Press.

Lesh, R., & Zawojewski, J. S. (2007). Problem solving and modeling. In F. K. Lester (Ed.), *Second handbook of research on mathematics* *teaching and learning* (pp. 763–804). Charlotte, NC: Information Age.

Leslie, A. M. (1987). Pretense and representation: The origins of "theory of mind." *Psychological Review, 94,* 412–426.

Lester, F. K. Jr. (Ed.). (2007). *Second handbook of research on mathematics teaching and learning* (pp. 763–804). Charlotte, NC: Information Age.

Levi, I. (1996). *For the sake of the argument.* Cambridge, UK: Cambridge University Press.

Liben, L. S., Kastens, K. A., & Christensen, A. E. (2011). Spatial foundations of science education: The illustrative case of instruction on introductory geological concepts. *Cognition and Instruction, 29,* 45–87.

Liu, Y., & Thompson, P. W. (2002). Randomness: Rethinking the foundations of probability. In D. Mewborn (Ed.), *Proceedings of the Twenty-fourth Annual Meeting of the International Group for the Psychology of Mathematics Education.* Athens, GA.

Lynch, M. (1990). The externalized retina: Selection and mathematization in the visual documentation of objects in the life sciences. In M. Lynch & S. Woolgar (Eds.), *Representation in scientific practice* (pp. 153–186). Cambridge, MA: MIT Press.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental knowledge in China and in the United States.* Mahwah, NJ: Erlbaum.

Maher, C. K. (2009). Children's reasoning. Discovering the idea of mathematical proof. In D. A. Stylianou, M. L. Blanton, & E. J. Knuth (Eds.), *Teaching and learning proof across the grades. A K-16 perspective* (pp. 120–132). New York, NY: Routledge.

Maher, C. K., & Martino, A. M. (1996). The development of the idea of a mathematical proof: A 5-year case study. *Journal for Research in Mathematics Education, 27,* 194–214.

Martin, W. G., & Harel, G. (1989). Proof frames of preservice elementary teachers. *Journal for Research in Mathematics Education, 20,* 41–51.

McClain, K., & Cobb, P. (2001). An analysis of development of sociomathematical norms in one first-grade classroom. *Journal for Research in Mathematics Education, 32,* 236–266.

Mead, G. H. (1910). Social consciousness and the consciousness of meaning. *Psychological Bulletin, 7,* 397–405.

Meira, L. (1995). The microevolution of mathematical representations in children's activity. *Cognition and Instruction, 13,* 269–313.

Meira, L. (2002). Mathematical representations as systems of notations-in-use. In K. Gravemeijer, R. Lehrer, B. Van Oers, & L. Verschaffel (Eds.), *Symbolizing, modeling, and tool use in mathematics education* (pp. 89–106). Dordrecht, The Netherlands: Kluwer.

Moschkovich, J. N. (1996). Moving up and getting steeper: Negotiating shared descriptions of linear graphs. *The Journal of the Learning Sciences, 5,* 239–277.

Munn, P. (1998). Symbolic function in pre-schoolers. In C. Donlan (Ed.), *The development of mathematical skills* (pp. 47–71). Hove, UK: Psychology Press, Taylor & Francis.

Nathan, M. J., & Knuth, E. J. (2003). A study of whole classroom mathematical discourse and teacher change. *Cognition and Instruction, 21* (2), 175–207.

National Research Council. (2001). *Adding it up: Helping children learn mathematics.* J. Kilpatrick, J. Swafford, & B. Findell (Eds.). Washington, DC: National Academy Press.

Nemirovsky, R., & Monk, S. (2000). "If you look at it the other way . . . ": An exploration into the nature of symbolizing. In P. Cobb, E. Yackel, & K. McClain (Eds.), *Symbolizing and communicating in mathematics classrooms. Perspectives on discourse, tools, and instructional design* (pp. 177–221). Mahwah, NJ: Erlbaum.

Nemirovsky, R., Tierney, C., & Wright, T. (1998). Body motion and graphing. *Cognition and Instruction, 16,* 119–172.

Newcombe, N. S., & Huttenlocher, J. (2000). *Making space.* Cambridge, MA: MIT Press.

Noss, R., & Hoyles, C. (1996). *Windows on mathematical meaning.* Amsterdam, The Netherlands: Kluwer.

Nunes, T. (1999). Mathematics learning as the socialization of the mind. *Mind, Culture, and Activity, 6,* 33–52.

O'Brien, D., Dias, M., Roazzi, A., & Braine, M. (1998). Conditional reasoning: The logic of supposition and children's understanding of pretense. In M. D. S. Braine & D. P. O'Brien (Eds.), *Mental logic* (pp. 245–272). Mahwah, NJ: Erlbaum.

Ochs, E., Gonzales, P., & Jacoby, S. (1996). When I come down I'm in the domain state: Grammar and graphic representation in the interpretive activity of physicists. In E. Ochs, E. A. Schegloff, & S. A. Thompson (Eds.), *Interaction and grammar* (pp. 328–369). Cambridge, UK: Cambridge University Press.

Ochs, E., Jacoby, S., & Gonzales, P. (1994). Interpretive journeys: How physicists talk and travel through graphic space. *Configurations, 2,* 151–171.

Ochs, E., Taylor, C., Rudolph, D., & Smith, R. (1992). Storytelling as a theory-building activity. *Discourse Processes, 15,* 37–72.

O'Connor, M. C., & Michaels, S. (1993). Aligning academic task and participation status through revoicing: Analysis of a classroom discourse. *Anthropology and Education Quarterly, 24,* 318–335.

O'Connor, M. C., & Michaels, S. (1996). Shifting participant frameworks: Orchestrating thinking practices in group discussion. In D. Hicks (Ed.), *Discourse, learning, and schooling* (pp. 63–103). Cambridge, UK: Cambridge University Press.

Olive, J. (1998). Opportunities to explore and integrate mathematics with the Geometer's Sketchpad. In R. Lehrer & D. Chazan (Eds.), *Designing learning environments for developing understanding of geometry and space* (pp. 395–417). Mahwah, NJ: Erlbaum.

Olson, D. R. (1994). *The world on paper.* Cambridge, UK: Cambridge University Press.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas.* New York, NY: Basic Books.

Penner, E., & Lehrer, R. (2000). The shape of fairness. *Teaching Children Mathematics, 7,* 210–214.

Petrosino, A., Lehrer, R., & Schauble, L. (2001). Structuring error and experimental variation as distribution in the fourth grade. *Mathematical Thinking and Learning*.

Piaget, J. (1970). *Genetic epistemology.* New York, NY: Norton.

Piaget, J., Inhelder, B., & Szeminska, A. (1960). *The child's conception of geometry.* New York: Harper and Row.

Pimm, D. (1987). *Speaking mathematically: Communication in mathematics classrooms.* London, UK: Routledge & Kegan Paul.

Polya, G. (1945). *How to solve it.* Princeton, NJ: Princeton University Press.

Porter, T. M. (1986). *The rise of statistical thinking 1820–1900.* Princeton, NJ: Princeton University Press.

Pozzi, S., Noss, R., & Hoyles, C. (1998). Tools in practice, mathematics in use. *Educational Studies in Mathematics, 36,* 105–122.

Pratt, D. (2000). Making sense of two dice. *Journal for Research in Mathematics Education, 31,* 602–625.

Resnick, M. (1994). *Turtles, termites, and traffic jams.* Cambridge, MA: MIT Press.

Rips, L. J. (1998). Reasoning and conversation. *Psychological Review, 105,* 411–441.

Rips, L. J., Brem, S. K., & Bailenson, J. N. (1999). Reasoning dialogues. *Current Directions in Psychological Science, 8,* 172–177.

Rips, L. J., & Marcus, S. L. (1976). Suppositions and the analysis of conditional sentences. In M. A. Just & P. A. Carpenter (Eds.), *Cognitive processes in comprehension.* (pp. 185–220). Hillsdale, NJ: Erlbaum.

Roese, N. (1997). Counterfactual thinking. *Psychological Bulletin, 121,* 133–148.

Rosch, E. (1973). Natural categories. *Cognitive Psychology, 4,* 328–350.

Roth, W. M., & McGinn, M. K. (1998). Inscriptions: Toward a theory of representing as social practice. *Review of Educational Research, 68,* 35–59.

Rotman, B. (1988). Toward a theory of semiotics of mathematics. *Semiotica, 72,* 1–35.

Rotman, B. (1993). *Ad infinitum.* Stanford, CA: Stanford University Press.

Saxe, G. B., & Esmonde, I. (2005). Studying cognition in flux: A historical treatment of *fu* in the shifting structure of Oksapmin mathematics. *Mind, Culture, & Activity, 12* (3&4), 171–225.

Schauble, L. (1996). The development of scientific reasoning in knowledge-rich contexts. *Developmental Psychology, 32,* 102–119.

Schoenfeld, A. H. (1988). When good teaching leads to bad results: The disasters of "well taught" mathematics courses. *Educational Psychologist, 23,* 145–166.

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334–370). New York, NY: Macmillan.

Schoenfeld, A. H. (1994). What do we know about mathematics curricula? *Journal of Mathematical Behavior, 13,* 55–80.

Schoenfeld, A. H., Smith, J. P., III, & Arcavi, A. (1993). Learning: The microgenetic analysis of one student's evolving understanding of a complex subject matter domain. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 55–175). Hillsdale, NJ: Erlbaum.

Schorr, R., & Clark, K. (in press). Using a modeling approach to analyze the ways in which teachers consider new ways to teach mathematics: Models and modeling in mathematics education [Monograph for *International Journal for Mathematical Thinking and Learning*]. Hillsdale, NJ: Erlbaum.

Schunn, C. D., & Anderson, J. R. (1999). The generality/specificity of expertise in scientific reasoning. *Cognitive Science, 23,* 337–370.

Scott, F. J., Baron-Cohen, S., & Leslie, A. (1999). "If pigs could fly": A test of counterfactual reasoning and pretense in children with autism. *British Journal of Developmental Psychology, 17,* 349–362.

Segal, J. (2000). Learning about mathematical proof: Conviction and validity. *Journal of Mathematical Behavior, 18,* 191–210.

Senechal, M. (1990). Shape. In L. A. Steen (Ed.), *On the shoulders of giants. New approaches to numeracy* (pp. 139–181). Washington, DC: National Academy Press.

Sfard, A. (2000). Symbolizing mathematical reality into being—Or how mathematical discourse and mathematical objects create each other. In P. Cobb, E. Yackel, & K. McClain (Eds.), *Symbolizing and communicating in mathematics classrooms. Perspectives on discourse, tools, and instructional design* (pp. 37–98). Mahwah, NJ: Erlbaum.

Sfard, A. (2008). *Thinking as communicating. Human development, the growth of discourses, and mathematizing.* Cambridge, UK: Cambridge University Press.

Sfard, A., & Kieran, C. (2001). Cognition as communication: Rethinking learning-by-talking through multi-faceted analysis of students' mathematical interactions. *Mind, Culture, and Activity, 8,* 42–76.

Shaffer, D. W. (1997). Learning mathematics through design: The anatomy of Escher's world. *Journal of Mathematical Behavior, 16,* 95–112.

Shaffer, D. W. (1998). *Expressive mathematics: Learning by design*. Unpublished doctoral dissertation, MIT, Cambridge, MA.

Shechtman, N., Roschelle, J., Haertel, G., & Knudsen, J. (2010). Investigating links from teacher knowledge, to classroom practice, to student learning in the instructional system of middle-school mathematics classrooms. *Cognition and Instruction, 28* (3), 317–359.

Sherin, B. L. (2001). A comparison of programming languages and algebraic notation as expressive languages for physics. *International Journal of Computers for Mathematical Learning, 6,* 1–61.

Sherin, M. G. (2001). Developing a professional vision of classroom events. In T. Wood, B. S. Nelson, & J. Warfield (Eds.), *Beyond classical pedagogy: Teaching elementary school mathematics* (pp. 75–93). Mahwah, NJ: Erlbaum.

Sherin, M. G. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video research in the learning sciences* (pp. 383–395). Mahwah, NJ: Erlbaum.

Sherin, M. G., & Han, S. Y. (2004). Teacher learning in the context of a video club. *Teaching and Teacher Education, 20,* 163–183.

Sherin, M. G., & van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education, 60,* 20–37.

Simon, M. A., & Blume, G. W. (1996). Justification in the mathematics classroom: A study of prospective elementary teachers. *Journal for Research in Mathematics Education, 15,* 3–31.

Smith, J. (2002). Everyday mathematical activity in automobile production work. *Journal for Research in Mathematics Education. Monograph*. *Vol. 11*. (pp. 111–130). Reston, VA: National Council of Teachers of Mathematics.

Spillane, J. P., & Zeuli, J. S. (1999). Reform and teaching: Exploring patterns of practice in the context of national and state mathematics reforms. *Educational Evaluation and Policy Analysis, 21,* 1–27.

Staples, M. (2007). Supporting whole-class collaborative inquiry in a secondary mathematics classroom. *Cognition and Instruction, 25,* 161–217.

Steffe, L., & Olive, J. (2009). *Children's fractional knowledge.* New York, NY: Springer.

Stein, M. K., Engle, R., Smith, M. S., & Hughes, E. K. (2008). Orchestrating productive mathematical discussions: Five practices for moving teachers beyond show and tell. *Mathematical Thinking and Learning, 10* (4), 313–340.

Stein, M. K., Grover, B., & Henningsen, M. (1996). Building student capacity for mathematical thinking and reasoning: An analysis of mathematical tasks used in reform classrooms. *American Educational Research Journal, 33,* 455–488.

Stevens, R., & Hall, R. (1998). Disciplined perception: Learning to see in technoscience. In M. Lampert & M. L. Blunk (Eds.), *Talking mathematics* (pp. 107–149). Cambridge, UK: Cambridge University Press.

Stewart, I. (1975). *Concepts of modern mathematics.* New York, NY: Dover.

Stewart, I. (1998). *Life's other secret.* New York, NY: Wiley.

Stewart, I., & Golubitsky, M. (1992). *Fearful symmetry: Is God a geometer?* London, UK: Penguin Books.

Strom, D., Kemeny, V., Lehrer, R., & Forman, E. (2001). Visualizing the emergent structure of children's mathematical argument. *Cognitive Science, 25,* 733–773.

Swan, M., Turner, R., Yoon, C., & Muller, E. (2007). The roles of modeling in learning mathematics. In W. Blum, P. L. Galbraith, H.-W. Henn, & M. Niss (Eds.), *Modeling and applications in mathematics education* (pp. 275–284). New York, NY: Springer.

Taplin, J. E., Staudenmayer, H., & Taddonio, J. L. (1974). Developmental changes in conditional reasoning: Linguistic or logical? *Experimental Child Psychology, 17,* 360–373.

Thompson, P. W. (1992). Notations, conventions, and constraints: Contributions to effective use of concrete materials in elementary mathematics education. *Journal for Research in Mathematics Education, 23* (2), 123–147.

Thurston, W. P. (1995). On proof and progress in mathematics. *For the learning of mathematics, 15* (1), 29–37.

Toulmin, S. E. (1958). *The uses of argument.* Cambridge, UK: Cambridge University Press.

Usiskin, U. (2007). The arithmetic operations as mathematical models. In W. Blum, P. L. Galbraith, H. W. Henn, & M. Niss (Eds.), *Modelling and applications in mathematics education* (pp. 257–264). New York, NY: Springer.

van Eemeren, F. H., Grootendorst, R., Henekemans, F. S., Blair, J. A., Johnson, R. H., Krabbe, E. C., . . . Zarefsky, D. (1996). *Fundamentals of argumentation theory.* Mahwah, NJ: Erlbaum.

van Oers, B. (2000). The appropriation of mathematical symbols: A psychosemiotic approach to mathematics learning. In E. Y. P. Cobb & K. McClain (Ed.), *Symbolizing and communicating in mathematics classrooms: Perspectives on discourse, tools, and instructional design* (pp. 133–176). Mahwah, NJ: Erlbaum.

van Oers, B. (2002). The mathematization of young children's language. In K. Gravemeijer, R. Lehrer, B. van Oers, & L. Verschaffel (Eds.), *Symbolizing, modeling, and tool use in mathematics education.* Dortrecht, The Netherlands: Kluwer.

Varelas, M. (1997). Third and fourth graders' conceptions of repeated trials and best representatives in science experiments. *Journal of Research in Science Teaching, 34,* 853–872.

Vygotsky, L. (1978). *Mind in society. The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Walkerdine, V. (1988). *The mastery of reason.* London, UK: Routledge.

Warren, B., Ballenger, C., Ogonowski, M., Rosebery, A. S., & Hudicourt-Barnes, J. (2001). Rethinking diversity in learning science: The logic of everyday sense-making. *Journal of Research in Science Teaching, 38,* 529–552.

Weber, K. (2010). Mathematics majors' perceptions of conviction, validity, and proof. *Mathematical Thinking and Learning, 12,* 306–336.

Wells, G. (1999). *Dialogic inquiry.* Cambridge, UK: Cambridge University Press.

Wertsch, J. V. (1998). *Mind as action.* New York, NY: Oxford University Press.

Wilensky, U. (2003). Statistical mechanics for secondary school: the gaslab multi-agent modeling toolkit. *International Journal of Computers for Mathematical Learning, 15,* 225–253.

Wilensky, U., & Resnick, M. (1999). Thinking in levels: A dynamic systems approach to making sense of the world. *Journal of Science Education and Technology, 8,* 3–18.

Wood, T. (1999). Creating a context for argument in mathematics class. *Journal for Research in Mathematics Education, 30*(2), 171–191.

Yackel, E., & Cobb, P. (1996). Sociomath norms, argumentation, and autonomy in mathematics. *Journal for Research in Mathematics Education, 27,* 458–477.

Zandieh, M., & Rasmussen, C. (2010). Defining as a mathematical activity: A framework for characterizing progress from informal to more formal ways of reasoning. *Journal of Mathematical Behavior, 29,* 57–75.

Zawojewski, J. Diefes-Dux, H., & Bowman, K. (Eds.) (2009) *Models and modeling in Engineering Education: Designing experiences for all students.* Rotterdam, The Netherlands: Sense.

Zawojewski, J., Chamberlin, M., Hjalmarson, M., & Lewis, C. (2008). Developing design studies in mathematics education professional development: Studying teachers' interpretive systems. In A. E. Kelly, R. A. Lesh, & J. Y. Baek (Eds.), *Handbook of design research methods in education: Innovations in science, technology, engineering, and mathematics learning and teaching* (pp. 216–245). New York, NY: Routledge.

CHAPTER 14

Engaged Learning With Digital Media: The Points of Viewing Theory

RICKI GOLDMAN, JOHN BLACK, JOHN W. MAXWELL, JAN L. PLASS,
AND MARK J. KEITGES

> Theories are dangerous things. All the same we must risk making one this afternoon since we are going to discuss modern tendencies. Directly we speak of tendencies or movements we commit to, the belief that there is some force, influence, outer pressure that is strong enough to stamp itself upon a whole group of different writers so that all their writing has a certain common likeness.
>
> —Virginia Woolf, "The Leaning Tower," lecture delivered to the Workers' Educational Association, Brighton (May 1940)

With full acknowledgement of the warning from the 1940 lecture by Virginia Woolf, this chapter begins by presenting a theory of mind, knowing only too well that "a whole group of different" learning theorists cannot find adequate coverage under one umbrella. Nor should they. However, there is a movement occurring, a form of social activism created by the affordances of social media, an infrastructure that was built incrementally during two to three decades of hard scholarly research that brought us to this historic time and place. To honor the convergence of theories and technologies, this paper revisits the *Points of Viewing Theory* to provide researchers, teachers, and the public with an opportunity to discuss and perhaps change the epistemology of education from its formal structures to more Do-It-Yourself (DIY) learning environments that dig deeper and better into content knowledge. As the saying goes, we live in interesting times. Let's not make this saying a curse. Let's "deschool" society as Ivan Illich suggested in 1971 and design more equitable systems of learning across mediated platforms.

The Points of Viewing Theory (POV-T) is the foundation on which this chapter on computers, the Internet, social media, embodied cognition, and interactive digital media learning environments, including games for learning, is constructed. According to this theory developed by Ricki Goldman (formerly Ricki Goldman-Segall), learners actively layer their viewpoints and their interpretations to elicit patterns, themes, and groupings of ideas that lead to a deep understanding of the content under investigation and to reach agreements—if only partial (Goldman, 2007; Goldman-Segall, 1996a, 1998a). POV-T is not limited to making meaning from a solitary standpoint. Indeed, the purpose of applying POV-T is to enable learners to learn from one another by seeing each other's viewpoints through perspective-taking as well as to be able to see *their own* changing perspectives on a subject in diverse contexts and settings. As Rowland points out: "We come to know through interpretation, dialog, and negotiation of meaning with . . . others, through a conversation with manipulation of the materials of a situation" (Rowland, 2004, p. 43).

The theory, first developed by Goldman in the 1990s, also strengthens content knowledge by layering the ideas of participants and stakeholders in a shared learning environment using a range of methods, tools, and "documents." POV-T also provides a framework for finding underlying patterns that lead to agreements. Tools that make evident this theory are called perspectivity technologies because they provide a *platform for multiloguing* (Goldman-Segall, 1994), a place and space for building cultures or communities of practice where one “catches sight” of the other while participating in learning. Given the problematics of living in a complex global society facing enormous cultural, social, environmental, and economic differences of opinion, this theory is critical for communicating with each other and reaching what Ivan Illich calls *conviviality* (1973), Clifford Geertz calls *commensurability* (1973), and Goldman-Segall (1995) calls *configurational validity*—a form of *thick communication,* which emerges from using media tools to layer views and perspectives into agreements.

POV-T incorporates how each person at different times and contexts will understand the same content whether it is a process, event, document in any media, or action “with new eyes.” Research on what Black (2010) calls the *embodied/grounded cognitive perspective* takes advantage not only of our visual perceptual systems for learning, but also our entire full body perceptual systems. Recent brain scanning research has shown that many cognitive tasks that were thought to be purely symbolic actually involved a multisensory perceptual simulation. The best preparation for such a task requires a fully embodied learning experience. The use of computer game-like learning environments (such as the Wii and Kinect) will continue to open the doors for exploration into how the social mind makes sense of experiences. Moreover, given the rise of social media and games for learning, as well as the recent findings on the plasticity of mental interpretations, the brain’s capacity for mental mirroring, and the intimate relationship between emotion and social intelligence that shows how minds can be reconfigured with changes to embodied experiences, the Points of Viewing Theory, a foundational theory of minds presented in this chapter, is the one that can move forward our understanding of learning with computers from the advent of early instructionist approaches to more recent constructionist and socioconstructionist applications.

In this chapter, the authors explore a range of concepts and tools that have been designed for learning. The authors expect that readers will create new configurations as they read the text. Indeed, that is the idea behind the theory—to learn from both a layering of each other’s ideas as well as from the diverse perspectives each of us, as solitary readers (if there is such a thing) can make meaning of different contexts to build knowledge, together.

CONTEXTS AND INTELLECTUAL HISTORY

We start by unfolding how the Points of Viewing Theory provides us with a lens from which to better connect the writings of past and present leading theorists. We do this to tease out some of the sticky webs that confuse policy makers and academicians, as well as to envision future directions. The underlying theme running through this chapter is that many routes combining a vast array of perspectives are needed to shape an educationally sound approach to learning and teaching with digital media technologies. There is no one fix, no one solution. Rather, there must be an openness to appreciate diversity and a layering of points of viewing.

In the late 19th and early 20th century, the age-old debate between empiricism and idealism shifted: Science could be used to not only observe the external world with microscopes and telescopes, but also to change, condition, and control behavior. Russian physiologist Ivan Pavlov experimented with dogs, calling his theory *conditioning.* Dogs “learned” to salivate to the sound of a bell that had previously accompanied their eating, even without receiving the food. Pavlov’s theory of conditioning played a central role in inspiring John B. Watson, who is often cited as the founder of behaviorist psychology. In 1913, Watson, while continuing to work with animals, applied Pavlov’s theories to children, believing that people act according to the stimulation of their nervous system and can just as easily as dogs be conditioned to learn. A turbulent personal turn of events—leading to his dismissal from Johns Hopkins University—extended Watson’s behaviorist approach into the domain of marketing. He landed a prime job as vice-president of J. Walter Thompson, one of the largest U.S. advertising companies, and helped change the course of advertising forever (Daniels, 2000). As media, education, and business enter a convergent course in this 21st century with new tools for learning and the new knowledge industry, behaviorist theories remain a strong and silent partner.

A leading proponent of behaviorism, Edward Thorndike, with his 1899 article on “Animal Intelligence” and subsequent book *Educational Psychology* in 1903, is often called the founder of the field of educational psychology. His educational psychology book made recommendations for teaching students, based on his research on animals (the Law of Effect and the Law of Exercise that establish connections between stimuli and responses). (He conducted studies with students, and not only animals, using this same basic framework.) The leading behaviorist in the educational domain, Burrhus Frederic (B.F.) Skinner, contributed the idea of *operant conditioning*—how positive and negative reinforcement (reward and punishment) can be used as stimuli to shape how humans respond. With this variation, the theory of behavior modification was born. All human actions are seen to be shaped (caused) by the stimulus of the external world on the body. In short, there is no *reasoning mind* creating reality, merely a hard-wired system that responds to what it experiences from external sources. Infamous for designing the glass "Air Crib," which his daughter—observed, measured, and "taught" how to behave—spent time living in, Skinner not only practiced what he preached, but also led the way for even more elaborate experiments to prove how educators could shape, reinforce, and manipulate humans through repeated drills. Much of this early work resurfaced in electronic learning systems today.

What was salient in the behaviorist approach was that the proponents addressed the role of external stimuli—that our bodies send messages to the brain that can be interpreted. What was missed was selectivity of the brain in interpreting how perceptions affect not only behavior, but create new perspectives layered on both internal predispositions and previously acquired interpreted experiences. In this chapter we propose that interactions among genetics, experience, and ongoing perceptual reactions along with what is felt in the whole body and interpreted in the mind are paramount to learning.

In short, even with the advent of new man-machine studies in the post–World War II period, the role of perspectivity has been missing as a key part of the interpretive executive functioning of the brain. Nevertheless, with the advent of the computer, intrepid behavioral scientists persisted in designing and using drill-and-practice methods to improve memorization tasks (e.g., Suppes, 1966). They turned to an examination of the role and efficacy of computers and technology in education, a subject understood in a behaviorist research agenda that valued measurable results and formal experimental methods, as Koschmann (1996, pp. 5–6) notes in his critique of the period. Accordingly, proponents of *Computer-Assisted Instruction* (CAI) in the 1960s, 1970s, and 1980s asked how the computer (an external stimulus) affects (modifies) the individual (a hard-wired learning system). Their research questions focused on how the process of learning could be improved by using the computer.

We see these classic debates between empiricism and idealism as being connected with bifurcation and a dualistic world view. It was not possible at the time to understand how the working of the brain, a network of perceptions, could be connected with perspectives, the interpretations that people as individuals and as a society, make. In short, an embodied notion of how learning is not internally nor externally "located." A holistic view of the world did not seem possible then, and for many scholars today, unfortunately, it remains an enigma.

An alternative approach to CAI is rooted in studying the individual mind and conducting experiments on how the mind works. The mind as a site of research (and not just idealization or speculation) has its modern roots in the work of Jean Piaget (b. 1896), a natural scientist trained in zoology but most renowned for his work as a developmental psychologist and epistemologist. After becoming disillusioned with standardized testing methodology at the Sorbonne in France, Piaget returned to Geneva in 1921 to dedicate the rest of his academic life to studying the child's conception of time (Piaget, 1969), space (Piaget & Inhelder, 1956), number (Piaget, 1952) and the world (Piaget, 1930). Although the idea that children could do things at one age that they could not do at another was not new, it was Piaget who was able to lay out a blueprint for children's conceptual development at different stages of their lives. For example, the classic theory of *conservation* eludes the young child: A tall glass contains more water than a short one even if the young child pours the same water from one glass into the other. Until Piaget, no one had conducted a body of experiments asking children to think about these phenomena and then mapped the diverse views that children use to solve problems into categories. By closely observing, recording his observations, and applying these to an emerging developmental theory of mind, Piaget and his team of researchers in Geneva developed the famous hierarchy of thinking stages: sensori-motor, preoperational, concrete, and formal. Piaget did not limit all thinking into these four rigid categories but rather used them as a way to deepen discussion on how children learn.

What is fundamentally different in Piaget's conception of mind is that unlike the behaviorist view that the external world affects the individual—a uni-directional approach with no input from the individual—the process of *constructivist* learning occurs in the mind of the child encountering, exploring, and theorizing about the world as the world is encountered as it moved through preset stages of life. The child's mind *assimilates* new events into existing cognitive structures and the cognitive structures *accommodate* the new event, changing the existing structures in a continually interactive process. *Schema* are formed as the child assimilates new events and moves from a state of disequilibrium to equilibrium, a state only to be put back into disequilibrium every time the child meets new experiences that cannot fit the existing schema. Beers (2001) has called the assimilation/accommodation process a *dialectical inter-action* among person, objects of creation (artifacts), and the curricular world in which the artifacts are created.

However, Piaget also believed that learning is a spontaneous, individual cognitive process, distinct from the sort of socialized and nonspontaneous instruction one might find in formal education, and that these two are in a somewhat antagonistic relationship. Critiquing Piaget's constructivism, the great Soviet psychologist L. S. Vygotsky wrote:

> We believe that the two processes—the development of spontaneous and of nonspontaneous concepts—are related and constantly influence each other. They are parts of a single process: the development of concept formation, which is affected by varying external and internal conditions but is essentially a unitary process, not a conflict of antagonistic, mutually exclusive forms of mentation. (Vygotsky, 1962, p. 85)

Vygotsky heralded a departure from individual mind to social mind, and, as under his influence, educational theorizing moved away from its individual-focused origins and toward more socially or culturally situated perspectives. The paradigmatic approaches of key theorists in learning technology reflect this change as contributions from anthropology and social psychology gained momentum throughout the social sciences. The works of Vygotsky and the Soviet cultural-historical school (notably A. R. Luria and A. N. Leontiev), when translated into English, began to have a major influence, especially through the interpretations and stewardship of educational psychologists like Sylvia Scribner, Jerome Bruner, and Michael Cole (Bruner, 1990; Cole & Engeström, 1993; Cole & Wertsch, 1996; Scribner & Cole, 1981). Vygotsky focused on the role of social context and mediating tools (language, writing, etc.) in the development of the individual, and argued that one cannot study the mind of a child without examining the "social milieu, both institutional and interpersonal" in which she finds herself (Katz & Lesgold, 1993). Vygotsky's influence, along with that of pragmatist philosopher John Dewey's seminal *Democracy in Education* (1916), opened up the study of technology in learning beyond individual cognition, thereby revealing its role in fostering social interaction and the betterment of a diverse, interconnected society. The ground in the last decade of the 20th century thus became fertile for a growing range of new media and computational environments for learning, teaching, and research based on new advances in brain-based cognitive science coupled with a socially mediated and distributed approach to the acqusition of knowledge (Pea & Bransford et al., 2000). This critical dichotomy between postpositivism and interpretivism would provide the philosophical inspiration for learning sciences research on technology in the first decade of the 21st century. But the path to social constructionism at the end of the 20th century first took a circuitous route through *computer-aided instruction.*

INSTRUCTIONAL TECHNOLOGY: CAI BEGINNINGS

An examination of the theoretical roots of computers in education exposes its behaviorist beginnings: The computer could reinforce activities that would bring about more efficient learning. For some, this meant "cheaper," for others, "faster," and for yet others, it meant without needing a teacher (see Bromley, 1998, for a discussion). The oldest such tradition of computing in education is Computer-Aided Instruction, or CAI. This approach dates back to the early 1960s, notably in two research projects, at Stanford under Patrick Suppes (1966), and the PLATO project at the University of Illinois at Urbana-Champaign under Donald Bitzer and Dan Alpert (1970). Both projects utilized the then-new "time-sharing" computer systems to create learning opportunities for individual students. The potential existed for a time-sharing system to serve hundreds or even thousands of students simultaneously, and this economy of scale was one of the main drivers of early CAI research. A learner could sit at a terminal and engage in a textual dialogue with the computer system: question and answer. As such, CAI can be situated mostly within the behavioral paradigm (Koschmann, 1996, p. 6), though its research is also informed by cognitive science (e.g., Suppes applied new cognitive learning and memory theories to guide the interactions with students).

The Stanford CAI project explored elementary school mathematics and science education, and the researchers worked with local schools to produce a formidable amount of research data (Suppes, Jerman, & Brian, 1968; Suppes & Morningstar, 1972). Suppes began with tutorial instruction as the key model, and saw that the computer could provide individualized tutoring on a far greater scale than was economically possible before. Suppes envisioned computer tutoring on three levels: The simplest is drill-and-practice work, in which the computer administers a question-and-answer session with the student, judging responses correct or incorrect, and keeping track of data from the sessions. The second level was a more direct instructional approach: The computer would give information to the student, and then quiz the student on the information, possibly allowing for different constructions or expressions of the same information. In this sense, the computer acts much like a textbook. The third level was to be more sophisticated dialogic systems, in which a more traditional tutor-tutee relationship could be emulated (Suppes, 1966). Clearly, the simple drill-and-practice model is the easiest to actually implement, and as such the bulk of the early Stanford research uses this model, especially in the context of elementary school arithmetic (Suppes et al., 1968).

The research results from the Stanford experiments are not surprising: students do tend to improve over time with practice. For the time (the 1960s), however, to be able to automate the process was a significant achievement. More interesting from our perspective are the reflections Suppes offers, regarding the design of the human-computer interface: How and when should feedback be given? How can the system be tailored to different cognitive styles? How best to leverage the unprecedented amount of quantitative data the system collected about each student's performance and progress? (Suppes, 1966). These questions still form the cornerstone of much educational technology research.

The PLATO (Programmed Logic for Automated Teaching Operations) project at UIUC had a somewhat different focus (Alpert & Bitzer, 1970). Over several incarnations of the PLATO system through the 1960s, Bitzer, Alpert, and their team worked at the problems of integrating CAI into university teaching on a large scale, as indeed it began to be from the late 1960s. The task of taking what was then enormously expensive equipment and systems and making it economically viable in order to have individualized tutoring for students drove the development of the systems, and led PLATO to a long career in CAI—in fact, the direct descendants of the original PLATO system are still being used and developed. The PLATO project introduced some of the first instances of computer-based manipulables, student-to-student conferencing, and computer-based "distance" education (Woolley, 1994).

From these beginnings, CAI and the models it provides for educational technology are now the oldest tradition in educational computing. While only partly integrated in the school system, CAI is widely used in corporate training environments, in remedial programs, and has had something of a resurgence with the advent of the World Wide Web as online training has become popular. It is worth noting that the company Suppes started with Richard Atkinson at Stanford in 1967, Computer Curriculum Corporation, and NovaNet, a PLATO descendant spun off from UIUC in 1993 were both recently acquired by Pearson Education, the world's largest educational publisher (Pearson Education, 2000).

COGNITIVE SCIENCE AND AI RESEARCH

In order to historically situate the development of learning technology, it is also important to appreciate the impact of the "cognitive revolution" (Gardner, 1985) on both education and technology.

For our purposes, the contribution of cognitive science is twofold. First, the advent of the digital computer in the 1940s led quickly to research on artificial intelligence (AI). By the 1950s, AI was already a substantial research program at universities like Harvard, MIT, and Stanford. And while AI research has not yet—nor, we believe, is likely to—produced an artificial mind, the legacy of AI research has had an enormous influence on our present-day computing paradigms, from information management to feedback and control systems and from personal computing to the notion of programming languages. All derive in large part from a full half-century of research in AI.

Second, cognitive science—specifically the contributions of Piagetian developmental psychology and AI research—gave the world the first practical models of mind, thinking, and learning. Prior to the cognitive revolution, our understanding of thinking was oriented either psychoanalytically or philosophically, out of the Western traditions of metaphysics and epistemology, or empirically, via behaviorism. In the latter case, as mentioned earlier, cognition was regarded as a black box between stimulus and response. Since no empirical study of the contents of this box was possible, speculation as to what went on inside was both discouraged and ignored.

Cognitive science, especially by way of AI research, opened the box. For the first time, researchers could work from a model of mind and mental processes. In 1957, AI pioneer Herbert Simon went so far as to predict that AI would soon provide the substantive model for psychological theory, in the same way that Newton's calculus had once done for physics (Turkle, 1984, p. 244). Despite the subsequent humbling of AI's early enthusiasm, the effect this thinking has had on research in psychology and education and even the popular imagination (consider the commonplace notion of one's "short term memory") is vast.

The most significant thread or thrust of early AI research was Allen Newell and Herbert Simon's "information processing" model at Carnegie-Mellon University. This research sought to develop a generalized problem-solving mechanism, based on the idea that problems in the world could be represented as internal states in a machine and operated on algorithmically. Newell and Simon saw the mind as a "physical symbol system" or "information processing system" (Simon, 1981 [1969], p. 27), and believed that such a system is the "necessary and sufficient means" for intelligence (p. 28). One of the venerable traditions of this model is the chess-playing computer, long bandied as exemplary of intelligence. Ironically, world chess master Gary Kasparov's historic defeat to IBM's "Deep Blue" supercomputer in 1997 had far less rhetorical punch than AI critic (and chess novice) Hubert Dreyfus' defeat in 1965, but the legacy of the information-processing approach cannot be underestimated.

Yet it would be unfair to equate all of classical AI research with Newell and Simon's approach. Significantly, research programs at Stanford and MIT, though perhaps lower profile, made significant contributions to the field. Two threads in particular are worthy of comment here. One was the development of "expert systems," concerned with the problem of knowledge representation—for example Edward Feigenbaum's DENDRAL, a system that contained large amounts of domain-specific information in biology. Another was Terry Winograd's 1970 program, SHRDLU, which first tackled the issue of indexicality and reference in an artificial microworld (Gardner,1985). As Gardner points out, these developments demonstrated that Newell and Simon's "generalized" problem-solving approach would give way to more situated, domain-specific approaches.

The culmination of this approach results in the Cognitive Tutors out of Carnegie Mellon University. These are both a successful product widely used in schools (www.carnegielearning.com) and an active ongoing research project (coordinated through the Pittsburgh Science of Learning Center: www.learnlab.org). The Cognitive Tutors apply John Anderson's ACTR (Anderson, 1993) cognitive architecture (which is descended from Newell and Simon's) to represent the knowledge to be taught (mostly If-Then production rules); then this knowledge is represented in the tutor so that it can understand what the student is doing when solving problems and provide "intelligence" feedback (Anderson, Corbett, Koedinger, & Pelletier, 1995). These tutors show impressive results in tests compared to classroom instruction and when compared to traditional CAI (like the Suppes kind): They do around one effect size (one standard deviation) better than classroom instruction—tradition CAI does 0.3 effect size better than classroom instruction so the Cognitive Tutors are 3 times as effective as traditional CAI (J. Kulik & C. Kulik, 1991). However, these Cognitive Tutors are effective at teaching how to solve problems in areas like high school algebra and geometry; there is some question remaining whether they can also teach an understanding of why these solution methods work.

At MIT in the 1980s, Marvin Minsky's work led to a theory of the "society of minds"—that, rather than intelligence being constituted in a straightforward representational and algorithmic way, intelligence is seen as the emergent property of a complex of subsystems working independently (Minsky, 1986). The notion of *emergent AI*, more recently explored through massively parallel computers, has with the availability of greater computing power in the 1980s and 1990s become the mainstream of AI research (Turkle, 1995, pp. 126–127). Interestingly, Gardner (1985) points out that the majority of computing—and therefore AI—research has been located within the paradigm defined by Charles Babbage, Ada Lovelace, and George Boole in the 19th century. Babbage and Lovelace are commonly credited with the basic idea of the programmable computer; Lady Ada Agusta, Countess of Lovelace (also known as Ada Lovelace), in a famous quote in Note 6 of her translation of the 1842 paper by L. F. Menabrea—written more than 170 years ago, called *Sketch of the Analytical Engine Invented by Charles Babbage*—neatly sums it up: "The analytical engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform." George Boole's contribution was the notion that a system of binary states (0 and 1) could suffice for the representation and transformation of logical propositions. But computing research began to find and transcend the limits of this approach. The rise of emergent AI was characterized as "waking up from the Boolean dream" (Douglas Hofstadter, quoted in Turkle, p., 135). In this model, intelligence is seen as a property emergent from, or at least observable in, systems of sufficient complexity. Intelligence is thus not defined by programmed rules, but by adaptive behavior within an environment.

From internal representation to situated action. The idea of taking contextual factors seriously became important outside of pure AI research, as well. A notable example was the reception given to Joseph Weizenbaum's famous program, ELIZA. When it first appeared in 1966, ELIZA was not intended as serious AI; it was an experiment in creating a simple conversational interface to the computer—outputting canned statements in response to certain "trigger" phrases inputted by a user. But ELIZA, with her reflective responses sounding a bit like a Rogerian analyst, became something of a celebrity—much to Weizenbaum's horror (Turkle, 1995, p. 105). The popular press and even some psychiatrists took ELIZA quite seriously. Weizenbaum argued against ELIZA's use as a psychiatric tool, and against mixing up human beings and computers in general, but ELIZA's fame has endured. The interface and relationship that ELIZA demonstrates has proved significant in and of itself, regardless of what computational sophistication may or may not lie behind it.

Another contextualist effort took place at Xerox' Palo Alto Research Center (PARC) in the 1970s, where a team led by Alan Kay developed the foundation for the "personal computing" paradigm we know today. Kay's team is most famous for developing the mouse-and-windows interface—which Brenda Laurel (1990) later called the *direct manipulation* interface. However, at a more fundamental level, the Xerox PARC researchers defined a model of computing that branched away from a formalist, rules-driven approach, and toward a notion of the computer as curriculum: an environment for designing, creating, and using digital tools. This approach partly came from explicitly thinking of children as the designers of computing technology. Kay wrote:

> We were thinking about learning as being one of the main effects we wanted to have happen. Early on, this led to a 90-degree rotation of the purpose of the user interface from "access to functionality" to "environment in which users learn by doing." This new stance could now respond to the echoes of Montessori and Dewey, particularly the former, and got me, on rereading Jerome Bruner, to think beyond the children's curriculum to a "curriculum of user interface." (Kay, 1996, p. 552)

In the late 1980s, Terry Winograd and Fernando Flores' *Understanding Computers and Cognition: A New Foundation for Design* (1986) heralded a new direction in AI and intelligent systems design. Instead of a rationalist, computational model of mind, Winograd and Flores described the emergence of a decentered and situated approach. The book drew on the phenomenological thinking of Martin Heidegger, the biology of perception work of Humberto Maturana and Francisco Varela, and the speech-act theory of John Austin and John Searle to call for a situated model of mind-in-the-world, capable of (or dependent on) commitment and intentionality in real relationships. Winograd and Flores' work raised significant questions about the assumptions of a functionalist, representational model of cognition, arguing that such a view is based on highly questionable assumptions about the nature of human thought and action.

In short, the question of how these AI and cognitive science developments have affected the role of technology in the educational arena can be summed up in the ongoing debate between instructionist "tutoring" systems and constructivist "toolkits." While the earliest applications of AI to instructional systems attempted to operate by creating a model of knowledge or a problem domain and then managing a student's progress in terms of deviation from that model (Suppes, 1966; Wenger, 1987), later and arguably more sophisticated construction systems looked more like toolkits for exploring and reflecting on one's thinking in a particular realm (Papert, 1980; Brown & Burton, 1978; Lajoi and Derry, 1993).

KINDS OF DIGITAL MEDIA LEARNING

When theorizing about the role of digital media environments in learning, the tendency is often to use an instrumentalist and instructionist approach—the computer, for example, is a useful tool for gathering or presenting information (which is often and incorrectly equated with knowledge). Even within the constructionist paradigm, the social dimension of the learning experience is forgotten, focusing only on the individual child. And, even when we remember the Vygotskian *zone of proximal development* (ZPD) with its emphasis on the socially mediated context of learning, we tend to overlook the differences that individuals themselves have in their learning styles when they approach the learning experience. And even when we consider group and individual differences, we fail to examine that individuals themselves try out many styles depending on the knowledge domain being studied and the context within which they are participating. And, most importantly, even when the idea that individuals have diverse points of viewing the world is acknowledged, technologists and new media designers often do little to construct learning environments that truly encourage social construction and knowledge creation.

Designing and building tools as perspectivity technologies, we argue, enables learners to participate as members of communities experiencing and creating new worlds from the points of viewing of their diverse personal identities while contributing to the public good of the digital commons. Using perspectivity technologies, learners—like stars in a constellation—are connected to each other within a force that enables them to change their position and viewpoint yet stay linked within the larger and also moveable construct of the total configuration of many constellations, galaxies, and universes. It is within the elastic tension among all the players in the community—the learner, the teacher, the content, the artifacts created, and most importantly the context of the forces within which they communicate—that new knowledge in, around, and about the world is created.

The next section has been organized less chronologically and more functionally, examining technologies from a variety of perspectives: as information sources, curricular areas, communications media, tools, environments, partners, scaffolds, and finally, as perspectivity toolkits. We also return to the importance of using the Points of Viewing Theory as a framework for designing new media applications and tools. These assorted technology approaches are not intended to be mutually exclusive; they are headers that often illustrate one aspect of a technology from a particular angle. How a technology should be characterized depends on how it is used *in situ.* A learning technology may be designed in a monological fashion, but while in the context of use it becomes dialogical with the presence of human actors (Bakhtin, 1981; Wegerif, 2007). And vice versa—technologies designed from a social constructionist framework may find their promise betrayed if used to serve instructionist goals and a single prevailing world view. With the explosion of ubiquitous learning with handheld devices in recent years, eroding the traditional distinction between formal and informal learning, the potential for complex, meaningful, dialogically rich learning is greater than it has ever been (Burbules, 2009). Within this context, it is essential to consider how perspectivity technologies can better accommodate these changes and provide a guiding light for future research and development.

Digital Media for Information

> When we investigate how meaning is made, we can no longer assume that actual social meanings, materially made, consist only in the verbal-semantic and linguistic contextualizations (paradigmatic, syntagmatic, intertextual) by which we have previously defined them. We must now consider that meaning-in-use organizes, orients, and presents, directly or implicitly, through the resources of multiple semiotic systems. (Lemke, 1998)

Access to information has been the dominant mythology of computers in education for many educators. Not taking the time to consider how new media texts bring with them new ways of understanding them, educators and educational technologists have often tried to add computers to learning as one would add salt to a meal. The idea of technology as information source has captured the imagination of school administrators, teachers, and parents hoping that problems of education could be solved by providing each student with access to the most current knowledge (Graves, 1999). It is no different these days: Legislators and policy makers are still trying to bridge the “digital divide.” As of 2012, the state of Maine is the only state in the United States with an Internet-connected computer on every desktop.

Although a growing number of postmodern theorists and semioticians see computers and new media technologies as *texts* to deconstruct (Landow, 1992; Lemke, 2001), it is more common to see computers viewed as *textbooks.* In spite of Lemke’s reminder that these new media texts require translation and not only digestion, the computer is commonly seen as merely a more efficient method of providing instruction and training, with *information* equated with *knowledge.* Learners working with courseware are presented with information and then tested or questioned on it, much as they would using traditional textbooks. The computer can automatically mark student responses to questions and govern whether or not the student moves on to the next section, freeing the teacher from this task—an economic advantage noted by many educational technology thinkers.

In the late 1980s, *multimedia*—audio, graphics, and video—dominated the educational technology landscape. Curriculum and learning resources, first distributed as textbook and accompanying floppy-disc, began to be distributed on videodisc or CD-ROM, media formats able to handle large amounts of multiple media information. In the best cases, multimedia resources employed *hypertext* or *hypermedia* (Landow, 1992; Swan, 1994) as navigation schemes, encouraging nonlinear traversal of content. Hypermedia, as such, represented a significant break with traditional, linear instructional design models, encouraging users to *explore* resources by following links between discrete chunks of information rather than simply following a programmed course. One of the best early exemplars was Apple Computer’s classic *Visual Almanac: An Interactive Multimedia Kit* (1989), which enabled students to explore rich multimedia vignettes about interesting natural phenomena as well as events from history and the arts.

The rise of Internet and search engines such as Google has stimulated the production of computer-based curriculum resources once again. As a sort of universal multimedia platform, the web's ability to reach a huge audience very inexpensively has led to its widespread adoption in schools, training centers, corporations, and, significantly, the home. More than packaged curriculum, however, the use of the Internet and World Wide Web as an open-ended research tool has had an enormous impact on classrooms. Since the software for browsing the web is free (or nearly free) and the technology and skills required to use it are so widespread, the costs of using the web as a research tool are largely limited to the costs of hardware and connectivity. This makes it an obvious choice for teachers and administrators often unsure of how to best allocate technology funds. The popular reputation of the web as a universal library or as access to the world's information (much more so than its reputation as a den of pornographers and pedophiles) has led to a popular mythology of children reaching "beyond the classroom walls" to tap directly into rich information sources, communicate with scientists and experts, and expand their horizons to a global view. Of course, such discourse needs to be examined in the light of day: The web is a source of bad information as well as good, and we must also remember that *downloading is not equivalent to learning.* As early as 2000, Roger Schank observed that

> [A]ccess to the Web is often cited as being very important to education, for example, but is it? The problem in the schools is not that the libraries are insufficient. The Web is, at its best, an improvement on information access. It provides a better library for kids, but the library wasn't what was broken. (Schank, 2000)

Indeed, he made a good point that the problem is elsewhere, yet within a short decade the "possibility" of better use of the access to a universe of materials has arrived. In a similar vein, "correspondence schools"—both university-based and private businesses dating back to the 19th century—are mirrored in today's crop of online distance learning providers (Noble, 1999). In the classic distance education model, a student enrolls, receives curriculum materials in the mail, works through the material and submits assignments to an "instructor" or "tutor" by mail. Hopefully, the student completes everything successfully and receives accreditation. Adding computers and networks to this model changes little, except for lowering the costs of delivery and management substantially (consider the cost savings of replacing human tutor/markers with an AI system). Again, in one decade, it is not uncommon for leading universities to offer high-quality online degrees. Most programs have some courses that are available to students, and the "push-back" from resistant faculty who associated Do-It-Yourself (DIY) learning has all but disappeared. Anya Kamenetz's 2010 *DIYU: Edupunks, Edupreneurs, and the Coming Transformation of Higher Education* became an instant read across higher education with blogs and tweets that raised fear throughout the academic establishment. The title of a May 3, 2010, article in *the Chronicle of Higher Education* by Seth Godin was "The Coming Meltdown in Higher Education (as Seen by a Marketer)." Jay Cross and colleagues from the Internet Time Alliance created the 2010 version of his "unbook," which he and his friends call *Working Smarter: Informal Learning in the Cloud.* Updates to the unbook can be found regularly by Cross and friends at www.internettime.com

Despite this current groundswell, the basic pedagogical questions about education remain: To what extent do learners in isolation actually learn? The introduction of electronic communication and conferencing systems into distance education environments has no doubt been shown to improve student's experiences (Hiltz & Goldman, 2005), and this has certainly been a widespread development, but the economic and educational challenges driving online learning still make it an ambivalent choice for both students and educators concerned with the learning process and accreditation. It will take a new system of evaluation of credentials before institutional bricks and mortar will become even close to obsolete. After two decades of introducing technologies into day-to-day work and study, institutions of higher education are finally responding with full force to create new kinds of learning environments that include formal and informal learning (ateliers and open community labs) as well as online mixed with face-to-face (f2f) classroom learning. The next major hurdle will be addressing global learning, a subject that New York University, for example, has moved into with full force with branches in Abu Dhabi and Shanghai, not to mention satellite programs and infrastructure in Buenos Aires, Paris, London, Florence, Acra, Singapore, Prague, London, Tel Aviv, and more recently, Madrid.

Digital Media for Literacy in STEM

Economic urgency and a chronic labor shortage in IT (Information Technologies) and STEM (Science, Technology, Engineering, and Mathematics) professions and the increasingly changing needs for updating computers and networks in the workplace continue to drive the demands for gaining design and computational literacy. Learning in both formal and informal settings, including businesses and schools, requires access to information and people who can design, build, and create curricular learning environments in disciplinary and cross-disciplinary areas. Although the field of technology studies as a program area has existed in high schools and universities since the 1970s, it is interesting how much variation there is in the curriculum, across grade levels, from region to region, and from school to school—perhaps increasingly so as years go by. Apart from the U.S. College Board's Advanced Placement (AP) Computer Science Curriculum, which is focused on professional computer programming, what one school or teacher implements as the "computer science" or "information technology" curriculum is highly varied, and probably dependent on individual teachers' notions and attitudes toward what is important. The range includes straightforward computer programming (as in the AP curriculum), multimedia production (Roschelle, Kaput, Stroup, & Kahn, 1998), technology management (Wolfson & Willinsky, 1998), exploratory learning (Harel & Papert, 1991), textbook learning about bits and bytes, and so on. Standards are hard to come by because the field is so varied and changing.

A most straightforward conclusion one may draw from looking at our economy, workplace, and prospects for the future is that computer-based technologies are increasingly part of how we work. It follows simply that knowing how to effectively use computers is a requirement for many jobs or careers. This basic idea drives the "job skills" approach to computers in education. In this model, computer hardware and software, particularly office productivity and data processing software, are the cornerstone of technology curriculum, because skill with these applications is what "employers are looking for." One can find this model at work in most high schools and it is dominant in retraining and economic development programs. And although its simple logic is easy to grasp, perhaps this model is a reminder that simple ideas can be limiting. Heeding this dilemma, Seymour Papert, invoking curriculum theorist Paolo Freire, writes,

> If "computer skill" is interpreted in the narrow sense of technical knowledge about computers, there is nothing the children can learn now that is worth banking. By the time they grow up, the computer skills required in the workplace will have evolved into something fundamentally different. But what makes the argument truly ridiculous is that the very idea of banking computer knowledge for use one day in the workplace undermines the only really important "computer skill": the skill and habit of using the computer in doing whatever one is doing. (Papert, 1992, p. 51)

Papert's critique of computer skills leads to a discussion of "computer literacy," a term almost as old as computers themselves, and one that is notoriously elusive. As far back as 1985, Douglas Noble noted that no one is sure what exactly computer literacy is, but everyone seems to agree that it is good for us (Noble, 1985, p. 64).

Sharon Derry and Daniel Zalles (2011) go beyond a theory of literacy to exploring how literacy is important for scientific civic reasoning. They propose "that active, collective citizenship through responsible civic reasoning, empowered by tools of science and technology, is an important educational goal of our time." They challenge the public to explore the connection between societal phenomena and discipline-based science, using a six-step approach: (1) seeking consensus around what is worth studying; (2) leveraging the power structures to ensure adequate funding; (3) operationalizing systematic research; (4) employing a "culture of principled, unbiased, constructive critical discourse"; (5) finding evidence for setting policy and taking civic action; and (6) evaluating effectiveness. In short, they argue that a civil society requires that children be literate/fluent with both civics and technologies.

Two books by John Willinsky, *The New Literacy* (1990) and *The Access Principle: The Case of Open Access to Research and Scholarship* (2006) expand on the idea that one needs to be "literate in literacy" (p. 236), a phrase we now change to *literate in digital literacies.* Willinsky's *The New Literacy* emerges from the roots of popular culture, the Progressive Education Movement, and even further back to the Romantics. It is grounded in the critical and yet inspirational work that can be reached through the thoughtful inquiry of teachers and students working together to redefine a new kind of learning place. In essence, the school becomes the language of this new literacy. Fifteen years later in *The Access Principle*, Willinsky focuses more on how we come to know and share what we know in open access digital environments. Pointing to a long history to make knowledge public, Willinsky encourages the movement of cloistered knowledges held in most part by institutional repositories toward the democratization of knowledge.

> [A]n open access to scholarly publishing is not simply a side issue, a matter of bussiness plans and delivery systems, in the pursuit of truth . . . . Rather, the potential expansion in the circulation of ideas is much about the quality of truth pursued in such settings. I would argue that the global scale

> of knowledge's circulation is critical to its very claim as knowledge. (2006, p. 34).

Certainly, Willinsky could not have predicted what came to be called the *Arab Spring* in 2011. In this time of protest against the existing regimes in individual countries (Tunesia, Egypt, Syria, etc.) that are embodied in the fight for greater freedom across the Arab world, we can see the impact of easy to use and accessible mobile technologies, as well as social media software such as Twitter and Facebook. These have given access to information that led to communities sharing their perspectives and critiquing existing traditions of truth through a more negotiated understanding of what was felt and understood on the ground. Although it is unclear how the quality of truth can ever be reached in complex international conflicts, perhaps what can be found in these contested spaces is incremental agreements that bring about verisimilitude, understanding, and a more general acceptance that differences of experiences and viewpoints can be negotiated through access to knowledge, resources, and power to make changes for the good of society—a quest that the Points of Viewing Theory was designed to facilitate. If Michel Foucault's book *Power/Knowledge* (1980) ever needed a rereading, it is in this particular time when our media tools help both laypeople and professionals interpret information in the quest to build a more just society.

Still, in this chapter, we must address the nature of computer literacy with new media technology in STEM learning in education. Early attempts to define computer literacy come from such influential figures as J. C. R. Licklider, one of the founders of what is now the Internet, and whose notion of computer literacy drew much on John Dewey's ideas about a democratic populus of informed citizens. As computers became almost ubiquitous in the first decade of the 21st century, people began what now seems like a lifelong exploration to understand the role of these new technologies in their lives. The inevitable reduction of "computer literacy" to a laundry list of knowledge and skills (compare with E. D. Hirsch's controversial *Cultural Literacy*) prompted Papert to respond with appeals to the richness of what "literacy" means:

> When we say "X is a very literate person," we do not mean that X is highly skilled at deciphering phonics. At the least, we imply that X knows literature, but beyond this we mean that X has *certain ways of understanding the world that derive from an acquaintance with literary culture.* In the same way, the term computer literacy should refer to the kinds of knowing that derive from computer culture. (1992, p. 52, *italics added*)

Other contributions to the notion of digital literacy remain rooted in the particular perspectives of their contributors. Alan Kay (1996) wrote of an "authoring literacy." Journalist Paul Gilster (2000) talked about "digital literacy." Andrea diSessa (1998; 2000), creator of the *Boxer* environment, wrote extensively on "computational literacy," a notion he projected that will rise above the banality of earlier conceptions.

> Clearly, by computational literacy I do not mean a casual familiarity with a machine that computes. In retrospect, I find it remarkable that society has allowed such a shameful debasing of the term *literacy* in its conventional use in connection with computers. (diSessa, 2000, p. 5)

Spiro, Collins, and Ramchandran (2007), an educational pioneer of how learning changes with hypermedia, multimedia, and now web-based interactive media, explained how learners become literate using the global and well-known approach called Cognitive Flexibility Theory (CFT). Using the following analogy of "criss-crossing landscapes," they weave a way for learners to gain "deep learning" in knowledge domains that are "ill-structured."

> When one criss-crosses landscapes of knowledge in many directions (the main instructional metaphor of CFT), drawn from Wittgenstein, a revisiting is not a repeating. The result is knowledge representations whose strength is determined not by a single conceptual thread running through all or most parts of the domain's representation, but rather from the overlapping of many shorter conceptual "fibers" (Wittgenstein, 1953), as befits an ill-structured domain. (Spiro, Collins, & Ramchandran, 2007, p. 96)

The difficulty of coming to terms with computer or digital literacy in any straightforward way has led Mary Bryson and Suzanne de Castell (1998) to identify the "miracle worker" discourse that results, in which "experts" are called on to step into a situation and implement the wonders that technology promises.

> [W]e hear that what is essential for the implementation and integration of technology in the classroom is that teachers should become "comfortable" using it . . . we have a master code capable of utilizing in one platform what for the entire history of our species thus far has been irreducibly different kinds of things . . . *every conceivable form of information can now be combined with every other kind to create a different form of communication, and what we seek is comfort and familiarity?* (de Castell, Bryson, & Jenson, 2000, *italics added*)

Familiarity and comfort, indeed! Bring on the affordances, they are proposing!

However difficult to define, some sense of "literacy" is going to be an inescapable part of thinking about digital technology and learning. If we move beyond a simple instrumental view of the computer and what it can do, and take seriously how it changes the ways in which we relate to our world, then the issue of how we relate to such technologies, in the complex sense of a *literacy,* will remain crucial.

Digital Media as Thinking Tool

David Jonassen is perhaps best known in the educational technology domain as the educator connected with bringing to prominence the idea of computer as *mindtool* (1996, 2005). Breaking rank with his previous instructionist approach detailing what he termed *frames for instruction* (Duffy & Jonassen, 1992), Jonassen's later work reflects the inspiration of leading constructionist thinkers like Seymour Papert. One of the classic quotations on the use of the computer as a tool from Papert's landmark book, *Mindstorms: Children, Computers, and Powerful Ideas* (1980), is:

> For me, the phrase "computer as pencil" evokes the kind of uses I imagine children of the future making of computers. Pencils are used for scribbling as well as writing, doodling as well as drawing, for illicit notes as well as for official assignments. (Papert, 210)

Although Papert did not predict Facebook and Twitter, he did say that technologies of the future would enable "illicit notes." Although it is easy to think of the computer as a simple tool—a technological device that we use to accomplish a certain task as we use a pen, abacus, canvas, ledger book, file cabinet, and so on—a tool can be much more than just a better pencil. It can be a vehicle for interacting with our intelligence—a thinking tool and a creative tool. For example, a popular notion is that learning mathematics facilitates abstract and analytic thinking. This does not mean that mathematics can be equated with abstract thinking. The computer as a tool enables learners of mathematics to play with the elements that create the structures of the discipline. To use Papert's example, children using the Logo programming language explore mathematics and geometry by manipulating a virtual "turtle" on the screen to act out movements that form geometric entities (Papert, 1980). Children programming in Logo think differently about their thinking, becoming epistemologists. As Papert would say, Logo is not just a better pencil for doing mathematics but a tool for thinking more deeply about mathematics, by creating procedures and programs, structures within structures, constructed, deconstructed, and reconstructed into larger wholes.

Papert led a groundbreaking series of research projects that brought computing technology to schoolchildren using Logo. In *Mindstorms,* Papert explained that Logo puts children in charge of creating computational objects—originally, by programming a mechanical "turtle" (a 1.5-foot-round object that could be programmed to move on the floor and could draw a line on paper as it moved around), and then later a "virtual" turtle that moved on the computer screen. A protégé of Jean Piaget, Papert was concerned with the difficult transition from "concrete" to "formal" thinking. Papert saw the computer as the tool that could make the abstract concrete:

> Stated most simply, my conjecture is that the computer can concretize (and personalize) the formal. Seen in this light, it is not just another powerful educational tool. It is unique in providing us with the means for addressing what Piaget and many others see as the obstacle which is overcome in the passage from child to adult thinking. (Papert, 1980, p. 21)

Beyond Piaget's notion of constructivism, the theory of *constructionism* focused its lens less on the stages of thought production and more on the artifacts that learners build as creative expressions of their understanding. Papert understood the computer as not merely being a tool (in the sense of a hammer) but as an *object-to-think-with* that facilitates novel ways of thinking.

> Constructionism—the N word as opposed to the V word—shares constructivism's connotation of learning as building knowledge structures irrespective of the circumstances of the learning. It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe. (Papert, 1991, p. 1)

By the late 1980s, the research conducted by the Learning and Epistemology Research Group at MIT was one of the most influential forces in learning technology research. A large-scale intensive research project called Project Headlight was conducted at the Hennigan School in Boston, studying all manner of phenomena around the experience of schoolchildren and Logo-equipped computers. A snapshot of this research is found in the edited volume, *Constructionism* (Harel & Papert, 1991), which covers the perspectives of 16 researchers. For example, Aaron Falbel and Ricki Goldman-Segall situated their research in Illich's theory of conviviality as described in *Tools for Conviviality* (Illich, 1973)—a theory that, in its simplest form, recommends tools be simple to use, accessible to all, and beneficial for humankind. Falbel worked with children to create animation from original drawings and to think of themselves as convivial learners (Falbel, 1989). Goldman-Segall conducted a three-year digital video ethnography of children's thinking styles in computer-rich learning cultures and created a computer-based video analysis tool called *Learning Constellations* to analyze her video cases (1990). In Judy Sachter's work, children explored their understanding of three-dimensional rotation and computer graphics, leading the way for understanding how children understand gaming (Sachter, 1990). At the same time, Mitchell Resnick, Steve Ocko, and Fred Martin designed smart LEGO bricks (crickets) controlled by Logo (Martin, 1995; Martin & Resnick, 1993; Resnick & Ocko, 1991). These Lego objects could be programmed to move according to Logo commands. Researcher Nira Granott asked adult learners to deconstruct how and why these Lego robotic creatures moved in the way they did. Her goal was to understand the construction of internal cognitive structures that allow an interactive relationship between creator and user (Granott, 1991).

Granott's theory of how diverse individuals understand the complex movements of Lego/Logo "creatures" was woven into a new fabric, which Resnick—working with Lego/Logo robots—called *distributed constructionism* (Resnick, 1991, 1994). Uri Wilensky, with Resnick, deepened the theoretical framework around the behavior of complex systems, introducing a "levels" framework (Resnick & Wilensky, 1998; Wilensky & Reisman, 2006; Wilensky & Resnick, 1999). To model, describe, predict, and explain emergent phenomena in complex systems, Resnick and Wilensky designed StarLogo; Wilensky has more recently designed the more widely used successor, NetLogo (Wilensky, 1999), which also includes a module for conducting participatory simulations (Wilensky & Stroup, 1999). Wilensky, a mathematician concerned with expanding mathematics education, connected it more to science education and to probability (Wilensky, 1993). He is often cited for posing a simple question to young people: How do geese fly in formation? The answers that young people give show how interesting yet difficult emergent phenomena are to describe.

Mathematics was an important frame for much of the research conducted in Project Headlight. Papert himself was a noted mathematician. In one study at the Hennigan School, Idit Harel worked with groups of children creating games in Logo for other children to use in learning about fractions (1991). The idea that children could be designers of their own learning environments was developed further by Yasmin Kafai who introduced computer design to understand how girls and boys think when playing and designing games, a topic of great interest to video game designers (Kafai, 1993, 1996). Kafai spent more than a decade creating a range of video game environments for girls and boys, which allow them to design environments for learning (and now works with more tactile digial textures). Kafai connected the world of playing and designing to the life of the classroom in a number of studies in the 1990s and early 2000s. Her current work at the University of Pennsylvania focuses on topics connected with the Learning Sciences, constructionism, games, virtual worlds, and gender.

Seymour Papert's legacy continues to grow and morph as his first generation of students from the early years at the MIT Media Lab expand their research in various academic and industry homes: Uri Wilensky at Northwestern University; Idit Harel at her company; WorldWide-Workshop; Carol Strohecker at the University of North Carolina; Edith Ackermann at MIT; Yasmin Kafai at the University of Pennsylvania; Mitchel Resnick at MIT; Ricki Goldman at New York University; Nira Granott at the University of Texas, Dallas; Fred Martin at University of Massachusetts, Lowell; Susan Imholz at Pepperdine; and David Schaffer at University at Wisconsin, Madison. Sustained for over 30 years now, this community of researchers has studied a range of learning environments using games, tools, robots, and video data analysis systems using a Papertian constructionist perspective that continues to spread among new generations of scholars. Constructionism may have taken on a more social, ecological and distributed approach than Papert first proposed, but these changes are to be expected given the changes in technologies in this same period.

Digital Media for Scaffolding

The computer as *scaffold* is yet another alternative to tool, environment, or partner. This version makes reference to Vygotsky's construct of the *zone of proximal development* (ZPD).

> [T]he distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (Vygotsky, 1978, p. 86)

The scaffold metaphor originally referred to the role of the teacher, embodying the characteristics of providing support, providing a supportive tool, extending the learner's range, allowing the learner to accomplish tasks not otherwise possible, and being selectively usable (Greenfield, 1984, p. 118).

Vygotsky's construct has been picked up by designers of educational software, in particular the CSILE project at the Ontario Institute for Studies in Education (OISE). At OISE, Marlene Scardamalia and Carl Bereiter worked toward developing a collaborative knowledge-building environment and asked how learners (children) could be given relatively more control over the ZPD through directing the kinds of questions that drive educational inquiry (Scardamalia & Bereiter, 1991). The CSILE environment provided a scaffolded conferencing and note-taking environment in which learners themselves could be in charge of the questioning and inquiry of collaborative work—something more traditionally controlled by the teacher—in such a way that kept the endeavor from degenerating into chaos.

Another example of technological scaffolding comes from George Landow's research into using hypertext and hypermedia—nonlinear, reader-driven text and media—in the study of English literature (Landow & Delany, 1993). In Landow's research, a student could gain more information about some aspect of Shakespeare, for example, by following any number of links presented in an electronic document. A major component of Landow's work was his belief in providing students with the context of the subject matter. The technological scaffolding provides a way of managing that context—so that it is not so large, or complicated, or daunting that it prevents learners from exploring, but flexible and inviting enough to encourage exploration beyond the original text. The question facing future researchers of these non-linear and alternate structures technologies may be this: Can the computer environment create a place in which the context or the culture, as anthropologist Clifford Geertz (1973) would say, is felt, understood, and can be communicated to others? More controversially, perhaps, can these technologies be designed and guided by the learners themselves without losing the richness that direct engagement with experts and teachers can offer them?

Digital Media for Cognitive Partnering

Somewhere amid conceiving of computing technology as artificial mind and conceiving of it as communications medium is the notion of computer as partner. This somewhat more romanticized version of "technology as tool" puts more emphasis on the communicative and interactive aspects of computing. A computer is more than a tool like the pencil that one writes with because, in some sense, it writes back. And although this idea has surely existed since early AI and ITS research, it wasn't until an important article in the early 1990s (Salomon, Perkins, & Globerson, 1991) that the idea of computers as "partners in cognition" was truly elaborated.

As early as the 1970s, Gavriel Salomon had been exploring the use of media (television in particular) and its effect upon childhood cognition (Salomon, 1979). Well versed in Marshall McLuhan's (1964) adage, *the medium is the message,* later to become *the medium is the massage,* Salomon has built a bridge between those who propose an instrumentalist view of media (media effects theory) and those who understand media to be a cultural artifact in and of itself. Along these lines, in 1991, Salomon, David Perkins, and Tamar Globerson drew a very important distinction:

> Effects *with* technology obtained during partnership with it, and effects *of* it in terms of the transferable cognitive residue that this partnership leaves behind in the form of better mastery of "skills and strategies." (Salomon, Perkins, & Globerson, 1991, p. 2)

Their article came at a time when the effects of computers on learners were being roundly criticized (Pea & Kurland, 1987; Sloan, 1985), and helped break new ground toward a more distributed view of knowledge and learning (Brown, Collins, & Duguid, 1996 [1989]; Pea, 1985 & 1993). To conceive of the computer as a partner in cognition—or learning, or work—is to admit it into the cultural milieu, to foreground the idea that the machine, in some way, has *agency* or at least influence in our thinking.

If we ascribe agency to the machine, we are going some way toward anthropomorphizing it, a topic Sherry Turkle has written about extensively (Turkle, 1984, 1995). Goldman-Segall writes of her partnership with digital research tools as "a partnership of intimacy and immediacy" (1998a, p. 33). MIT interface theorist Andrew Lippman defined interactivity as mutual activity and interruptibility (Brand, 1987), and Alluquere Rosanne Stone goes further, referring to the partnership with machines as "a prosthetic device" for constructing desire (Stone, 1995). Computers are, as Alan Kay envisioned in the early 1970s, *personal* machines.

The notion of computers as cognitive partners is further exemplified in research conducted by anthropologist Lucy Suchman at Xerox. Suchman's *Plans and Situated Actions: The Problem of Human- Machine Communication* explored the difference between rational, purposive plans, and circumstantial, negotiated, situated actions. Rather than actions being imperfect copies of rational plans, Suchman showed how "plans" are idealized representations of real-world actions. With this in mind, Suchman argued that, rather than working toward more and more elaborate computational models of purposive action, researchers give priority to the contextual situatedness of practice:

> A basic research goal for studies of situated action, therefore, is to explicate the relationship between structures of action and the resources and constraints afforded by physical and social circumstances. (Suchman, 1987, p. 179)

Suchman's colleagues at Xerox PARC in the 1980s designed tools as structures within working contexts; innovative technologies such as collaborative design boards, real-time virtual meeting spaces, and video conferencing between co-workers were a few of the environments at PARC where people could *scaffold* their existing practices.

Media for Social Constructionism

Historically, constructivist learning theories were rooted in the epistemologies of social constructivist philosopher John Dewey, social psychologist Lev Vygotsky, and developmental and cognitive psychologist Jerome Bruner. Knowledge of the world is seen to be constructed through experience; the role of education is to guide the learner through experiences that provide opportunities to construct knowledge about the world. In Piaget's version, this process is structured by the sequence of developmental stages. In Vygostsky's cultural-historical version, the process is mediated by the tools and contexts of the child's sociocultural environment. As a result of the influence of Vygotsky's work, researchers in a variety of institutions view the computer and new media technologies as environments, drawing on the notion that learning happens best for children when they are engaged in creating personally meaningful digital media artifacts and sharing them publicly. Learning and Epistemology Group, the Center for Children and Technology, Vanderbilt's Cognition and Technology Group, TERC, the Concord Consortium in Boston, Georgia Tech, and SRI are just a few of the exemplary research settings involved in the exploration of learning and teaching using technologies as learning environments during the 1990s. Several of these communities (SRI International, Stanford, Berkeley, and the Concord Consortium) formed an association called CILT, the Center for Innovation in Learning and Teaching, which became a hub for researchers from many institutions. More recently, a National Science Foundation Science of Learning Center called LIFE (Learning in Informal and Formal Environments), was established. It is hosted at the University of Washington in partnership with Stanford University and SRI International.

The range of methodological perspectives employed in these various research institutions, however, is as diverse as might be expected. Moreover, the discussion about what constitutes good research varied from community to community with some using mostly qualitative methods and others using quantitative measures and methods. Qualitative research methods, with their emphasis on case studies and in-depth analyses, best describe the conclusions of a study that is constructionist by design. Constructionists tend to be interested in digging around in the complexity of a small set of events while instructionists tend to focus on the organization of a larger set of variables. An instructionist tends to first look at a whole system and then break the whole into smaller units to be learned or processed; constructionists build up. They put together small units and combine micro-procedures into the elements—or chunks—of larger structures and wholes. This does not mean that constructionists do not have plans as they tinker or play with computational objects. Far from it; constructionists have plans which are in continual flux as the parts of any whole program are built, assembled, and integrated (Suchman, 1987). Even the smallest change in a procedure can dramatically alter the outcome of a program. The designer/constructionist "tweaks" code at both top and bottom levels in the infinite refinement of an artifact.

When individuals and groups create digital media artifacts, those artifacts then inhabit the learning environment, creating an ecology that we share with one another and with our media constructions. Technology can be seen as an expressive tool that allows learners to manipulate *objects-to-think-with* and through exploration and reflection to come to more formal understandings of systems and relationships. Technology is thus not just an instrument we use within an environment, but is part of the social and ecological environment itself.

Digital Media for Collaborative and Distance Learning

The most significant advancement of collaborative learning with computers is the development of the Computer-Supported Collaborative Learning (CSCL) community, which hosts a bi-annual conference and a journal called the *International Journal of Computer-Supported Collaborative Learning.* In a 1996 article, Timothy Koschmann suggested that the major educational technology paradigm of the late 1990s would be CSCL, a close relative of the emerging field of computer-supported collaborative work (CSCW). Educational technology, Koschmann pointed out, is now concerned with collaborative activities, largely using networks and computer conferencing facilities. Whether CSCL constitutes a paradigm shift is a question that is yet to be answered, but Koschmann's identification of the trend is well noted. Two oft-cited research papers by Margaret Riel (and colleagues) fit into this category: Margaret Riel, James Levin, and colleagues on "teleprenticeship" (Levin, Riel, Miyake, & Cohen, 1987) and "learning circles" (Riel, 1993, 1996). Learning circles connected many students at great distances—classroom to classroom as much as student to student—in large-scale collaborative learning.

Hiltz and Turoff's *Network Nation* (1978), although originally concerned mostly with business communications and management science, explored teaching and learning with network technologies, applying their insights to practical problems of teaching and learning online.

> In general, the more the course is oriented to teaching basic skills (such as deriving mathematical proofs), the more the lecture is needed in some form as an efficient means of delivering illustrations of skills. However, the more the course involves pragmatics, such as interpretations of case studies, the more valuable is the CMC [Computer Mediated Communication] mode of delivery. (Hiltz & Turoff, 1993 [1978], p. 471)

Looking a bit further back in time, one needs to reflect for a moment on the earliest beginnings of this research. It is often credited to the work of Douglas Engelbart at SRI in the 1960s (Bootstrap Institute, 1994). Englebart's work centered on the oNLine System (NLS), a combination of hardware and software that facilitated the first networked collaborative computing, setting the stage for workgroup computing, document management systems, electronic mail, and the field of *computer-supported collaborative work* (CSCW).

The first computer conference management information system, EMISARI, was created by Murray Turoff while working in the U.S. Office of Emergency Preparedness in the late 1960s, and was used for monitoring disruptions and managing crises. Turoff continued developing networked, collaborative computing at the New Jersey Institute of Technology (NJIT) in the 1970s, working with Starr Roxanne Hiltz. Turoff and Hiltz founded the field of *computer-mediated communication* (CMC) with their landmark book, *The Network Nation* (1993 [1978]). The book describes a new world of computer conferencing and communications, and is to this day impressive in its comprehensive insightfulness. Hiltz and Turoff's work inspired a generation of computer mediated communication researchers, notably including technology theorist Andrew Feenberg (1987) at San Diego State University, and Virtual-U founder Linda Harasim (1990, 1993) at Simon Fraser University.

Parallel to the early development of CMC, research in CAI (Computer Assisted Learning) began to take seriously the possibilities of connecting students over networks. As mentioned earlier, the PLATO system at the University of Illinois was probably the first large-scale distributed CAI system. PLATO was a large time-sharing system, designed (and indeed economically required) to support thousands of users connecting from networked terminals. In the 1970s, PLATO began to offer peer-to-peer conferencing features, making it one of the first online educational communities (Woolley, 1994).

Distance education researchers were interested in CMC, too, as an adjunct to or replacement for more traditional modes of communication, such as audio teleconferencing and the postal service. The British Open University was an early testbed of online conferencing. A. W. Bates (1988) and Alexander Romiszowski and Johan de Haas (1989) were looking into the opportunities presented by computer conferencing and the challenges of conducting groups in these text-only environments. Bates has written extensively about the management and planning of technology-based distance education, drawing on two decades of experience building "open learning" systems in the United Kingdom and Canada (Bates, 1995).

In the 1990s, Hiltz wrote extensively about Computer Mediated Communication (CMC) and education. Her 1994 book, *The Virtual Classroom*, elaborates a methodology for conducting education in computer-mediated environments, emphasizing the importance of assignments using group collaboration to improve motivation. Hiltz hoped that students would share their assignments with the community rather than being "mailed" to the instructor. Hiltz was surely a pioneering player in online learning during the late 1980s and early 1990s, inspiring researchers around the world to realize the promise of "anyplace, anytime" learning (Harasim, 1993), as well as and study the dynamics of teachers and learners in online asynchronous conferencing systems.

Roxanne Hiltz and Ricki Goldman (2005), in their collaboration on an edited book called *Learning Together Online: Research on Asynchronous Learning Networks*, discuss the past, present, and future educational research on Asynchronous Networked Learning (ALN) community. In their final chapter, the researchers remind us that being part of a social network is about growing a culture of learners. Using the example of jazz players, they note,

> [W]hile some artists say they find that the required social networking keeps them away from their real passion, creating their works, many maintain that the continual push and pull with . . . the social world of their artistry enables them to see things with a greater perspective when returning to their work. What we are describing is a culture where the learners' drive to create is appreciated, the artifacts that are created have a public sphere to be shown in, and the system is supported because it offers important values to the healthfulness of society. In short, cultures are created supporting members' activities and these cultures then produce sub-cultures while affecting changes to the overall culture. (Goldman & Hiltz, 2005.)

In the early 1990s, students, teachers, and researchers around the world began to engage in networked collaborative projects. At the Institute for the Learning Sciences (ILS) at Northwestern University, the Collaborative Visualization (Co-Vis) project involved groups of young people in different schools conducting experiments and gathering scientific data on weather patterns (Edelson, Pea, & Gomez, 1996).

Research at the Multimedia Ethnographic Research Lab (MERLin) at the University of British Columbia focused on how young people, teachers, and researchers conducted ethnographic investigations on a complex environmental crisis at Clayoquot Sound on the west coast of Vancouver Island (Goldman-Segall, 1994), with the aim of communicating with other young people in diverse locations. The Global Forest project was centered on a CD-ROM database of video but used the World Wide Web to allow participants from around the world to share diverse points of viewing and interpretation of the video data.

At the TERC research center, large-scale collaborative projects were designed in conjunction with the National Geographic Society Kids Network (Feldman, Konold, & Coulter, 2000; Tinker, 1996). The TERC project was concerned with "network science" and as with Riel's learning circles, multiple classrooms collaborated together, in this case gathering environmental science data and sharing in its analysis.

> For example, in the NGS Kids Network Acid Rain unit, students collect data about acid rain in their own communities, submit these data to the central database, and retrieve the full set of data collected by hundreds of schools. When examined by students, the full set of data may reveal patterns of acidity in rainfall that no individual class is able to discover by itself based on its own data. Over time, the grid of student measurements would have the potential to be much more finely grained than anything available to scientists, and this would become a potential resource for scientists to use. (Feldman, Konold, & Coulter, 2000, p. 7)

One of the most interesting developments in CMC since the advent of the Internet is immersive virtual reality environments—particularly MUDs and MOOs—within which learners can meet, interact, and collaboratively work on research or constructed artifacts (Bruckman, 1998; Dede, 1994; Haynes & Holmevik, 1998). Virtual environments, along with the popular but less interesting "chat" systems on the Internet, add synchronous communications to the asynchronous modes so extensively researched and written about since Hiltz and Turoff's early work. One could position these immersive, virtual environments as perspectivity technologies, as they create spaces for participants to create and share their worlds.

There were many who predicted the cultural, social, economic, and educational impact of the Internet as a site for collaboration. Indeed, from the standpoint of the 21st century, most nonmaterial collaborations and works created collaboratively, in some way, involve the Internet. The result is that all education computing is a communications system, involving distributed systems, peer-to-peer communication, telementoring, or some similar construct—quite as Roxanne Star Hiltz and Murray Turoff predicted in the 1970s. Along with "social media" as a common activity, perspectivity technologies (technologies that enable, encourage, and expand users' points of viewing) can be designed to create more democratic, interactive, convivial, and contextual communication that involve stakeholders' decisions (Goldman-Segall, 2000; Goldman & Dong, 2009). Goldman and Dong also discus the POV-T in relation to multimedia representations for teaching, learning, and research in socially networked learning environments.

The Internet has clearly opened up enormous possibilities for shared learning. The emergence of broad standards for Internet software has lent a stability and relative simplicity to learning software. Moreover, the current widespread availability and use of Internet technologies could be said to mark the end of CMC as a research field unto itself, as it practically merges CMC with all manner of other conceptualizations of new media technological devices: CAI, intelligent tutoring systems, simulations, robotics, smart boards, wireless communications, wearable technologies, pervasive technologies, and even smart appliances.

Digital Media as Perspectivity-Sharing

Social media and interactive video and computer games are engaging because they involve the perspectives and opinions of users who contribute to their networked communities. Using *Perspectivity Technologies,* learners/participants become collaborators, curators, creators, and builders, layering their viewpoints and becoming connected with each other in ways that enable commensurability. Commensurabilty is a state where understanding of each other's cultures is reached, if only temporarily.

One could trace the first glimmer of perspectivity technologies to Xerox' PARC in the 1970s. There, Alan Kay was inventing what we now recognize as the "personal computer," a small, customizable device with substantial computing power, mass storage, and the ability to handle multiple media formats. Kay's advances, while simply pedestrian today, were at the time revolutionary. Kay's vision of small, self-contained *personal* computers was without precedent, as was his vision of how they would be used: as *personalized* media construction toolkits that would usher in a new kind of literacy. With this literacy would start the discourse between technology as scientific tool and technology as personal expression.

> The particular aim of [Xerox' Learning Research Group] was to find the equivalent of writing—that is, learning and thinking by doing in a medium—our new "pocket universe." (Kay, 1996, p. 552)

At Bank Street College in the 1980s, a video and videodisc project called *The Voyage of the Mimi* immersed learners in scientific exploration of whales and Mayan cultures. Learners identified strongly with the student characters in the video stories. Similarly, the Cognition and Technology Group at Vanderbilt (CTGV) were working on video-based units in an attempt to involve students in scientific inquiry (Martin, 1987). *The Adventures of Jasper Woodbury* was a series of videodisc-based adventures, which provided students with engaging content and contexts for solving mysteries and mathematical problems (Vanderbilt Learning Technology Center website). While both of these environments were outstanding exemplars of students using various media forms to get to know the people and the culture within the story structures, the lasting contribution is not only one of enhanced mathematical or social studies understanding, but rather a connection to people who are engaged in real-life inquiry.

With an AI orientation, computer scientist, inventor, and educator Elliot Soloway at the University of Michigan built tools to enable learners to create personal hypermedia documents, reminiscent of Kay's personalized media construction toolkits. Soloway and his colleagues continue to study project-based science through the design of sophisticated technologies developed for distributed knowledge construction since their landmark article called "The casebook of project practices: An example of an interactive multimedia system for professional development" (Krajcik et al., 1996). Complementary pioneering work started by Marcia Linn at Berkeley analyzed the cognition of students who wrote programs in the computer language LISP, and Andrea diSessa, also at Berkeley, who studied students learning physics using his program called *Boxer.* For diSessa, physics deals with,

> [A] rather large number of fragments rather than one or even any small number of integrated structures one might call "theories." Many of these fragments can be understood as simple abstractions from common experiences that are taken as relatively primitive in the sense that they generally need no explanation; they simply happen. (diSessa, 1988, p. 52)

Andrea diSessa's theory of physics resonates strongly with the notion of *bricolage,* a term first used by the French structural anthropologist Claude Lévi-Strauss (1968) to describe a person who builds from pieces and does not have a specific plan at the onset of the project. Lévi-Strauss was often used as a point of departure for cognitive scientists interested in the analysis of fragments rather than in building broad generalizations from top-down rationalist structures. By the 1990s, French social theory has indeed infiltrated the cognitive paradigm, legitimizing cultural analysis.

Strongly influenced by the notion of bricolage, Goldman-Segall's (now Goldman) early digital ethnographies of children's thinking (1990, 1991, 1998) and more recent collaborative studies with her colleagues about girls' prototyping video games to promote mathematics learning in low socio-economic communities are rich examples of perspectivity theory. In these works, Goldman establishes unique partnerships among viewer, author, and media texts: a set of partnerships that revolves around, and is revolved around, the constant recognition of cultural connections as core factors in using new-media technologies.

Situating her digital ethnographic work in Clifford Geertz's notion of the thick description, Goldman explores the tenuous, and often permeable, layered relations between creator, user, and media artifact through an online environment for video analysis (1989, 1998). A video segment, for example, is the representation of a moment in the making of cultures. A video object is a cultural object and also a "personal subject-to think-with," something to turn around and reshape together. And, just as we change it through our manipulation, so it changes both our cultural possibilities and us. A fuller description of this theory can be found in the volume, *Video Research in the Learning Sciences* (Goldman, Pea, Barron, & Derry, 2007), published with 67 learning science video researchers.

Another example of a perspectivity technology is described in the doctoral work of Maggie Beers, who explored preservice teachers' learning of modern languages to build and critique digital artifacts connecting self and other (Beers, 2001; Beers & Goldman-Segall, 2001). Beers has shown how groups of preservice teachers create video artifacts as representations of their various cultures in order to share and understand each others' perspectives as an integral part of learning a foreign language. The self becomes a strong reference point for understanding others while engaged in many contexts with media tools and artifacts.

Another exemplary application of perspectivity theory is demonstrated by Gerry Stahl. Stahl has been working on the idea of perspective and technology at the University of Colorado for more than a decade. His *WebGuide* forms the technical foundation into an investigation of the role of artifacts in collaborative knowledge building for deepening perspective. Drawing on Vygotsky's theories of cultural mediation, Stahl's work develops models of collaborative knowledge building, and the role of shared cultural artifacts—and particularly digital media artifacts—in that process (Stahl, 1999).

In sum, perspectivity technologies enhance, motivate, and provide new opportunities for learning, teaching, and research because they address how the personal point of view connects with evolving discourse communities. Perspectivity thinking tools enable knowledge-based cultures to grow, creating both real and virtual communities within the learning environment to share information, to alter the self/other relationship, and to open the door to a deeper, richer partnership with our technologies and one another. Just as a language changes as speakers alter the original form, so does the nature of discourse-communities change as cultures spread and variations of meanings are co-constructed.

Digital Media for Playing and Learning With Games

Video and computer games are popular and motivating environments, and there have been calls to use them as a way to get students more engaged in education and to use them as effective environments for learning (e.g., Prensky, 2007). James Gee (2007) makes the case that video games have many of the characteristics that learning science researchers often recommend for the design of effective learning environments. When well-designed digital games represent conceptual play spaces in which learners/players can work in teams or by themselves to creatively solve problems, develop and test hypotheses, and investigate the game system and its rules (Barab, Sadler, Heiselt, Hickey, & Zuiker, 2007; Shaffer, 2006), learners can play at their own pace, set their own goals, and regulate their own exploration behaviors in an environment that also engages them on behavioral, cognitive, and emotional levels (Domagk, Schwartz, & Plass, 2010). However, the results from studies of how people learn content from and with video games are mixed. This suggests that careful research is needed to show under what conditions games are effective for learning.

What we do know at this time is that experimental research has shown strong improvements of basic perceptual and cognitive processes as a result of playing certain video games. Several studies have shown that action games, that is, video games that require players to divide their attention over multiple targets (e.g., *Halo*), result in significant increases in players' contrast sensitivity, as well as in the players' ability to do divided attention tasks, which is a basic attention cognitive skill (Green & Bavelier, 2003; Greenfield, deWinstanley, Kilpatrick, & Kaye, 1994). Play of video games using visual and spatial skills (e.g., *Tetris*) also increases those basic cognitive processes (Subrahmanyam & Greenfield, 1994); and, play of action video games (e.g., *Unreal Tournament*) results in increased spatial resolution and visual acuity (Green & Bavelier, 2007).

To understand the benefit of using video games in a learning context, one needs to examine their potential future function in the learning process. Heuristics of existing games suggest four such functions: (1) prepare for future learning, (2) teach new knowledge or skills, (3) automate existing knowledge or skills, and (4) acquire 21st-century skills (Plass, Perlin, & Isbister, 2010).

Preparation for future learning. Games to prepare for future learning do not aim to teach specific knowledge or skills, but to provide learners with a shared experience based on which content can be taught. Game genres typically used for such games therefore include adventure games, open-ended simulation games, and role-playing games where students have an opportunity to take on different perspectives through role playing. Research by Hammer and Black (2009) suggests that the best use of video games in content (and perhaps other) learning might be in providing experience with the subject matter that will lead to better future learning of related material from a more formal learning setting. In one study, Hammer and Black looked at expert players of the *Civilization* history simulation game and found that these expert players did not know any more about the historical content contained in the game than expert players of another unrelated game (*Sim City*) did. So far, this is consistent with the comparison research on content learning with video games. However, this study also examined how much the expert Civilization players would learn from reading a college textbook chapter on related historical content, and found that the Civilization players learned much more from reading the chapter than the expert players of the Sim City comparison game. Thus, having the experience of grappling with historical issues in the game may have provided the players with a set of experiences, as John Dewey (1938) said, that better prepared them for future learning from a more formal learning approach (Bransford & Schwartz, 2001).

A related approach is the Teachable Agents Project at Stanford and Vanderbilt. Using the Teachable Agents system, students learn by creating a concept map for a topic (e.g., river ecology) that then becomes what their online agent (avatar) knows about the topic. The system then puts questions to the agent and the students can see how well they know the topic by how well the agent does (and revise their and their agents' knowledge by changing the concept map and trying again). There is even a version where students' agents can "play" against each other in a simulated TV quiz show, so that the students can see which concept maps work the best. Experimental research studies showed that students learning with Teachable Agents learned better (especially causal chains) than alternative approaches like standard classroom instruction and using concept maps.

Teach new knowledge and skills. A strong case can be made that most if not all games teach the learner new knowledge or skills (Gee, 2007). However, the effectiveness or efficacy of games for learning at a large scale has not yet been sufficiently investigated. Disagreement among researchers exists whether the very features that make games motivating and engaging—the use of narratives to provide context and relevance, the design of emotional experiences, opportunities for discovery and exploration, and the use of compelling visual representations—facilitate learning or whether they introduce extraneous cognitive processing demands on working memory that suppress learning (Kirschner, Sweller, & Clark, 2006).

Studies that have compared learning academic content (as opposed to attention and visual-spatial cognitive skills) have shown negative results for learning from video games. For example, Egenfeldt-Nielsen (2005) compared learning about European history from playing a history simulation game to learning the same content in a classroom, and found that students learned more from the classroom. Similarly, Mayer, MacNamara, and Adams (2011) found that students learned more about ecology by merely going through PowerPoint slides than they did from playing an ecology simulation game.

On the other hand, qualitative and observational studies have showed student learning from video games (Barab, Zuiker, Warren, Hickey, Ingram-Goble, Kwon, & Herring, 2007; Squire, 2004). These results suggest that more sophisticated research methods have to be employed that use both qualitative and quantitative data in an interwoven way, such as through the adoption of Goldman-Segall's Points of Viewing Theory (1998), to investigate the effectiveness of games for the acquisition of new knowledge and skills.

The game-plus approach entails game learning in conjunction with other activities. Consistent with this games-plus approach, Steinkuehler and Duncan (2009) found that players of Massively Multiplayer Online Games like *World of Warcraft* show informal scientific reasoning skills in online discussion forums, which are supplements to the games and where players share their experiences. Another study consistent with this approach is Ahn (2007) and Black (2011), who looked at college undergraduates learning from an entrepreneurship simulation game (from Harvard Business School) as part of an entrepreneurship college course. The study found that students learned much more from playing the game (multiple times) when they also reflected on and articulated their business and game-playing strategies, and related them to background readings in textbooks for the course (this is like the college textbook reading in the Hammer and Black study). They did not learn nearly as much from the game play if they did not reflect on how it relates to this background reading.

All of the video game studies covered so far involve students learning from playing video games. However, a different, but effective, approach to video games and learning is to have students learn by creating video games themselves. Early studies by Harel (1991) and Kafai (1995) showed that students learned more about both fractions and computer programming (the Logo programming language designed for kids) if they created educational software or computer games to teach other students about fractions than they did if they learned about fractions and computer programming separately. Building on this work, Harel (now Harel Caperton) has established an online social networking environment called *World Wide Workshop* for kids to learn by creating online games (www.worldwideworkshop.org/). In related and more recent work, Fadjo and Black (2011) have found that having students act out what they want their video game avatars to do, then programming a simple video game in which the avatars perform these actions (see discussion of embodied cognition in this chapter), is a more effective way for students to learn the programming and math skills than having them learn in alternative ways.

In a games and gender study involving the game *Rapunsel,* designed to teach middle school girls how to program by using a Java-like language to customize the avatars in the game, the strongest impact of the game was not on cognitive learning outcomes. After using the game for only four sessions, students' general self-efficacy, programming-related self-efficacy, and self-esteem increased significantly, suggesting that games are able to impact learners' identity formation in a way that positively changes their attitudes toward their ability to perform science-related tasks (Plass, Goldman, Flanagan, & Perlin, 2009).

Automate existing knowledge or skills. The majority of games used for learning do not aim to teach significant new knowledge or skills, but are designed to help the learner automate existing skills, such as basic arithmetic, algebra, Newtonian mechanics, history, or others. Game genres used for such games therefore typically include puzzle games, platformers, labyrinth games, and race games, often implemented as relatively short mini games. Research has shown that such games provide a venue for players to use their knowledge of biological and physical science topics, such as the water cycle (Lim, Nonis, & Hedberg, 2006) and principles of electromagnetism (Squire, Barnett, Grant, & Higginbotham, 2004), as well as math topics, such as measurement, whole numbers, equations, and graphing (Ke & Grabowski, 2007). Children as young as six years of age have been found to develop stronger numeracy skills after playing computer games that provide practice in number sense and counting (Rasanen, Salminen, Wilson, Aunio, & Dehaene, 2009). At the high school level, videogames have been found to be effective tools for the reinforcement of algebra skills in an immersive three-dimensional environment (Kebritchi, Hirumi, & Bai, 2010) as well as computer science concepts integrated into a labyrinth game (Papastergiou, 2009).

Acquire 21st-century skills. Many games do not aim to teach academic knowledge or skills, or to automate existing knowledge or skills, but rather focus on the development of skills that have collectively come to be known as 21st-century skills, although most of them have been recognized for many decades, if not centuries, to be important predictors of success in life. These skills include creative problem solving, communication skills, team collaboration, emotional intelligence, and many others. Game genres typically used for such games include adventure games and role-playing games with large numbers of players, which are known as MMOs (Massive Multiplayer Games). Studies have shown that such games facilitate the acquisition of systems-based reasoning and social knowledge construction (Steinkuehler & Duncan, 2009), collaborative problem solving (Squire, 2004), and civic thinking (Bagley & Shaffer, 2009).

All of the studies cited above assume that the games used in the investigations were well designed to facilitate learning. However, as Plass, Homer, and Hayward (2009) have shown, the design of games for learning is a highly complex and difficult process for which very little theory-based, empirically validated guidance for designers exist. Another line of research has therefore been concerned with the identification of design patterns for effective games for learning. This research, which is in part based on research of the design of effective simulations, has shown that icons are effective visual representations of key information, especially for younger learners and learners with low prior knowledge in the subject matter (Homer & Plass, 2010; Plass, Homer, Milne et al., 2009).

Other research has investigated the mode of play for games teaching math skills, comparing collaborative play and competitive play to a single player version of a game. Results indicate that players enjoy playing with others more (in collaborative or competitive mode) and solve more problems in the competitive mode, but that they acquire a higher math fluency, an expression of the acquired math skills, when playing by themselves.

A final study investigated the use of different learning mechanics in a game to teach middle school geometry.

Players were asked to solve missing angles in order to clear the path for their avatar to free a peer from imprisonment. One mechanic was designed to require the player to compute the correct value of the missing angle and enter this number as response, whereas another mechanic asked learners to identify which rule (e.g., complementary angles rule, supplementary angles rule, opposite angles rule, or the like) they would apply to solve the problem. Results suggest that computing the correct angles value was more situationally interesting than identifying the correct rule. However, participants in the rule condition were found to perform better in the game than those in the number condition. Results further suggest that in the number condition, but not the rule condition, playing more levels in the game diminishes the gain from pretest to posttest (Plass, Homer, Hayward et al., 2011).

Games are an emerging medium for learning that requires research concerning both its effectiveness for learning and related design patterns. This research topic would benefit from mixed methods, or what Goldman and colleagues call Quisitive Research (Goldman, Crosby, Swan, & Shea, 2005; Goldman-Segall, 1996; Goldman, 2007). In quisitive research, perspectives from a fuller range of stakeholders use both quantitative and qualitative research methods along with emerging digital text and video tools for data analysis in order to investigate the topic further.

Emotion, Empathy, Affective Computing, and Pespective-Taking

The history of emotional and social learning can be said to date back to John Dewey's *Experience in Education.* It became a "mantra" of the Civil Rights Movement as well as the progressive, cooperative, and whole child movements of the 1960s and 1970s. Currently, the cluster of terms being used includes: social and emotional, empathetic learning, affective computing, and perpective-taking learning. According to Zins and Elias (2006):

> [S]ocial and emotional learning (SEL) is the capacity to recognize and manage emotions, solve problems effectively, and establish positive relationships with others . . . SEL is the process of acquiring and effectively applying the knowledge, attitudes, and skills necessary to recognize and manage emotions; developing caring and concern for others; making responsible decisions; establishing positive relationships; and handling challenging situations capably. (Zin & Elias, 2006, p. 1)

A series of research projects undertaken by computer scientist Rosalind Picard are aimed at investigating the emotional and environmental aspects of digital technologies. This work on "affective computing" (Picard, 1997, 2010) researches areas that include computer recognition of human affect, computer synthesis of affect, wearable computers, and affective interaction with computers. (See www.media.mit.edu/affect/.)

Needless to add, emotional learning has been of interest in the use of *persuasive technologies* in political and product advertising campaigns, as Ian Bogost (2007) points out. In educational research on gaming, interest in the emotional aspect of designing games for social good as well as on developing historical empathy are currently at the forefront of renewed interest in emotions and learning.

Belman and Flanagan (2010) argue that "games are particularly well-suited to supporting educational or activist programs in which the fostering of empathy is a key method or goal." As we discussed in the previous section, there is growing interest in harnessing the power of games for education. Belman and Flanagan ask: Why not design games to advance empathy and social activism? Some software interaction designers and academics have proposed that engaging players on the emotional level is a key element of their use. Sasha Barab and his colleagues (2005) designed Quest Atlantis, for example, which promotes children's educational and activist pursuits by engaging them with a fantasy that resonates at an emotional meta-level of cognition. Belman and Flanagan suggest that activist designers would find it useful to encourage empathetic play, a mode of play in which

> Players intentionally try to infer the thoughts and feelings of people or groups represented in the game, and/or they prepare themselves for an emotional response, for example by looking for similarities between themselves and characters in the game. (Belman & Flanagan, 2010, p. 5-15)

Taking a curricular and epistemological perspective, James Diamond asks: How does game play in a history video game influence students' achievement of *historical empathy*? Although historical empathy is a construct that connotes "perspective taking-in-historical-context", Diamond includes *theory of mind* in the construct. Using the video game, *Mission US*, he describes not only *if* players' abilities to achieve historical empathy change in the course of game play, but *how* students play and if their playing can inform future designs of games constructed to help students contextualize other people's thinking and behaviors (Diamond, 2012). Ashby and Lee

(Ashby & Lee, 1987; Lee & Ashby, 2001)—who are often cited as the pioneers of work on empathy in history education—would be pleased to read this emerging work by Diamond.

Emotional learning, including empathy development, is a major theme for the future of educational research with digital media environments. Moreover, emotional learning along with social learning using social media, and embodied learning using interactive Wii and Kinect-like environments constitute the convergence of not only new digital media technologies, but also of a new paradigm of learning that depends upon the willingness of learners to share viewpoints and knowledge with each other. As Picard (2010), in an article titled "Emotion Research by the People, for the People," asks: How do we remind ourselves as researchers that the public as well must become part of the scholarly discourse, and that together we explore this new domain called emotional learning and perspective-taking?

> Today when a child teaches a distinguished scientist to upload video on the Internet, when non-researchers can participate in scientific labeling from home, and when gathering autonomic nervous system data 24/7 is as easy as slipping on a sweatband, emotion research is ready for a major leap forward. Ordinary people can gather data, upload it, compare their patterns, share what they learn, and if they wish, share it with scientists for emotion research. Research can be done by the people, for the people. Of course scientists still have to be involved: there is no substitute for deep scholarly study across experiments and for the rigorous development and test of new hypotheses and theories. At the same time, *there is no longer any excuse for leaving people out of findings. Emotion research can benefit all its participants, scientists and laypeople, instead of becoming academic in the modern definition.* (Picard, 2010, *italics added*)

Digital Media for Embodied Cogntion/Learning

Some of the current criticisms of traditional formal learning suggest: Learning can be fragile and lacking in depth; learning does not become a part of the way the student thinks about and interacts with the everyday world; and students too often forget what they have learned if it does not get applied to relevant situations outside the learning setting. In the 2010s, as new technological environments such as Wii and Kinect allow for a more physical interaction, this technology along with an embodied cognition approach may provide a new approach to what it means to learn. Along with the increased interest in emotions, the nervous system, neurobiology, as well as tools for leaving traces of our activities and emotional responses, cognitive science has also taken on this term to use Gibbs' (2006) statement that "conceptual systems and thought processes are shaped by body-based interactions and experiences in the world" (Kwah & Goldman, 2011). In this same paper, they add that emotional experiences influence cognition and must play a role in engagement in learning. As Gibbs so aptly wrote: "The brain is certainly part of an integrated dynamic system devoted to the moment-by-moment embodied dynamic of everyday life" (p. 9). He goes on to claim that "the regularities in people's kinesthetic-tactile experience not only constitutes the core of their self-conceptions as persons, but form the foundation for higher-order cognition (p. 15).

We emphasize that an embodied approach can provide guidance for the design of new kinds of learning environments that can make knowledge more accessible, useable, and beneficial for society, in accordance with the three tenets of Ivan Illich's definition of *convivial tools* (1973). For the purpose of this paper on the advances of digital media and how they affect learning, this means that embodied digital media tools and environments can provide an alternative to the scenario of designing learning for the solitary person sitting in front of a monitor.

One increasingly prominent approach to cognition is called the embodied or perceptually grounded learning approach. This approach proposes that a full understanding of something involves being able to create a mental perceptual simulation of it when retrieving the information or reasoning about it (Barsalou, 2008; Glenberg, 1997). Both behavior and neuroimaging results have shown that many psychological phenomena that were thought to be purely symbolic show perceptual effects. For example, property verification (e.g., retrieving the fact that a horse has a mane) was thought to involve a search from a concept node (horse) to a property node (mane) in a symbolic propositional network, and thus the time to answer and errors was determined by how many network links needed to be searched and how many other distracting links were present. However, embodied cognition research shows that perceptual variables like size (e.g., more important properties are retrieved faster) affect verification times and errors. Also, neuroimaging results (e.g., fMRI) show that perceptual areas of the brain (involving shape, color, size, sound, and touch) also become active during this task, not just the symbolic areas. Thus, if one is familiar with horses and manes then doing even this simple property verification involves a perceptual simulation.

Glenberg, Gutierrez, Levin, Japuntich, and Kaschak (2004) discuss teaching reading comprehension by using a grounded cognition approach. These studies found that having second-grade students act out stories about farms using toy farmers, workers, animals, and objects increased their understanding and memory of the story they read. Further, if the students also imagined these actions for another related story after acting it out with the toys, they seemed to acquire the skill of forming the imaginary world of the story (Black, 2007) when reading other stories, and this increased their understanding and memory of these stories. Thus, this grounded cognition approach increased the students reading comprehension. These studies also seem to indicate that there are three steps involved in a grounded cognition approach to learning something new: have an embodied experience; learn to imagine that embodied experience; and imagine the experience when learning from symbolic materials. Interestingly, it has also been shown that moving objects corresponding to story characters on a computer screen works just as well as moving toy objects in the physical environment (Glenberg, Goldberg, & Zhu, 2009).

An example of using an embodied cognition approach to designing learning environments and the learning advantages of doing so is provided by the graphic computer simulations with movement and animation that Han and Black (in press) used in perceptually enhancing the learning experience. Chan and Black (2006) found that graphic computer simulations involving movement and animation were a good way to learn functional relations between system entities. Han and Black (in press) have enhanced the movement part of these interactive graphic simulations by adding haptic force feedback to the movement using graphic and sound simulations. Here the student moves the gears shown in the screen by moving a joy stick, and then bar graphics on the screen show the input and output force levels for the two gears. Allowing the student to directly manipulate the gears enhances the students' learning, and enriching the movement experience by adding force feedback increases the students' performance even more. Thus the richer the perceptual experience, and therefore the mental perceptual simulation acquired, the better the student learning and understanding.

Black, Segal, Vitale, and Fadjo (2012) reported on a number of embodied cognition technology learning environment projects and concluded that the richer the perceptual environment using multiple sensory modalities (e.g., using visuals, voiceovers, and movement) during initial learning, the better the student learning. Secondly, they found that utilizing movements (e.g., gestures) that are conceptually congruent with the knowledge being learned increases student performance, learning, understanding, and motivation. A third finding was that students who directly experience a phenomenon through activities like acting it out by moving their own bodies, learn about the topic in a more general way, which also increases learning, understanding, and motivation. A similar, fourth conclusion was reached by embodying their understanding in surrogates and then observing the surrogate behavior through activities like programming video-game-like virtual environments with avatar surrogates (with the Scratch programming environment) and programming robot surrogates like the LEGO NXT. Other recent technological developments, such as the Wii, offer mathematics-education researchers new ways of investigating deep cognitive and epistemological questions pertaining to the nature of knowing, learning, and teaching. For example, in Gerofsky's study of secondary school students' learning about the features of graphs, such as roots, extrema, symmetries, asymptotes, reflections over certain lines, domain, and range, she found that embodied work appears to contribute to secondary school students' mathematical engagement and understanding (Gerofsky, 2011). She notes:

> An integrated pedagogy that moves back and forth among explicit teaching of new concepts, embodied exploration of the "feel" and "sound" of mathematical graphs, and sessions of mathematical inquiry and problem solving would appear to be an ideal kind of balanced program to promote mathematical understanding.

Another increasingly prominent approach to embodied cognition has been proposed by Dor Abrahamson, director of the Embodied Design Research Lab at University of California, Berkeley.

The EDRL research group uses design-based research and video analysis to study embodied mathematics learning, along with a growing group of researchers in a variety of research universities and labs (Antle, Corness, & Droumeva, 2009; Cress, Fischer, Moeller, Sauter, & Nuerk, 2010; Dam, 2011; Goldman et al., 2011; Howison, Trninic, Reinholz, & Abrahamson, 2011; Leong & Horn, 2011; Kwah & Goldman, 2011; Nemirovsky, Tierney, & Wright, 1998). Abrahamson's research group creates useful empirical settings to pursue the (somewhat controversial) grounded-cognition conjecture that mathematical reasoning is not encoded and processed in the mind in the form of amodal symbols, but rather is enacted and evoked as embodied, dynamical, multimodal schemes. This conjecture can be traced back to the work of phenomenology philosophers (Heidegger, 1962; Merleau-Ponty, 1958/2005), yet it is converging with perspectives and empirical findings from the cognitive and learning sciences (Barsalou, 2010; Bruner, Oliver, & Greenfield, 1966; Dourish, 2001; Goldin, 1987; Hommel, Müsseler, Aschersleben, & Prinz, 2001; Núñez, Edwards, & Matos, 1999; Piaget & Inhelder, 1969; Skemp, 1983).

In one type of embodied-interaction design being investigated by Abrahamson and collaborators (Abrahamson, Trninic, Gutiérrez, Huth, & Lee, 2011; Petrick & Martin, 2011), students interact with the Mathematical Imagery Trainer for Proportion (hence, "MIT-P"). The MIT-P is an embodied-interaction system designed to foster the development of perceptuomotor schemas grounding notions of proportion. Participants use both hands to remote-control a pair of virtual objects on a computer display monitor, one object per each hand, in attempts to "make the screen green." The screen will be green only if the hands rise proportionately, in accordance with an unknown ratio set on the instructor's console. Once students determine qualitative interaction principles, such as "the higher you go, you need a bigger distance between the hands," mathematical instruments are interpolated onto the screen, such as a Cartesian grid and numerals. Students develop the cognitive foundations of proportions via objectifying and articulating their *a* mathematical solution strategies using the available semiotic resources (Bamberger & diSessa, 2003; Bartolini Bussi, & Mariotti, 2008; Radford, 2003).

As such, Abrahamson's MIT tasks are defined in terms of a specified goal state of an interactive system, which the student is to effect—that is, a target phenomenal invariance that the student is to generate. As a learning activity, this task is dramatically different from traditional schoolwork, because the solution method is unknown to the child. Moreover, this task is different from what mathematicians do, because there is no theorem to prove. Rather, this task is closest to forms of inquiry that scientists engage, for example, a botanist who first encounters a specimen of an unknown species and is trying to understand its properties, or a chemist who has discovered a new element and is attempting to determine its reactions to various agitations. But then again, scientists who discover an undocumented phenomenon or material do not know a priori its potential behaviors that they have yet to witness (e.g., green), so that their interactions with the phenomenon are not oriented toward generating any specified goal state. As such, the MIT task is rather unique.

In addition to analyses of student unmediated discovery (Abrahamson et al., 2011), researchers have examined the design from the perspectives of human computer interaction (Howison et al., 2011), design heuristics (Abrahamson et al., 2011), and design process (Trninic, Reinholz, Howison, & Abrahamson, 2010).

Yet another approach to understanding embodied learning includes a close look at classroom gestures, perspectivity (Goldman-Segall & Maxwell, 2003), and "cubist compositions" (Nemirovsky et al., 1998). Nemirovsky, who was inspired by his work with Seymour Papert's notion of becoming the turtle when learning programming, along with Ferrara, propose that mathematical reasoning proceeds through a process of imagining a situation from various viewpoints, through a form of "cubist composition" en route to articulating the rules and principles that unify knowledge of the whole. In their studies, they found that gestures were an essential modality for composing these partial perspectives of the whole.

The perspective of the gesture has received little attention in studies of gestures in classroom learning with the exception of studies by Crowder and colleagues (Crowder, 1996; Crowder & Warburton, 1995). Crowder's studies indicated that first- and third-person perspectives in gesture reflected different knowledge orientations with a subjective, exploratory approach to knowing reflected in first-person perspectives, and a summative approach reflected in the third person. Many representational gestures convey a sense of being performed from a first- or third-person perspective, what has been termed the "character viewpoint" (McNeill, 1992). Crowder's work as well as McNeill's resonates closely with the theoretical underpinnings of Edith Ackermann's focus on perspective-taking (Ackermann, 1996). In that same period, Goldman-Segall took a similar view on the need for subjective, first-person perspective as a way to reach configurational validity (1995)—multiple viewpoints that become robust by "looking through layers" of interpretation (1996). Students learn to program by building physical artifacts that represent a first-person embodied object/subject-to-think-with. Enabling children to not only create their first-person viewpoints, but also critically share their collective viewpoints, building *thick interpretations* (2008, p. 24, 1998). For example, demonstrating the embodied understanding of children learning to make circles in the Logo programming language, Goldman-Segall's film called *The Growth of a Culture* (1988) shows a group of girls making a circle with their bodies. When asked to make a circle as the Logo turtle would, Tnisha did not turn 360 degrees from one standpoint, but rather walked around the circle as the turtle icon in Logo would have done: forward 50, right angle 90 degrees, over and over again. At the same time, she looked into the camera saying that the circle is "right here," while she gently pounded her left chest with her right palm of her hand. Papert, in a filmed documentary by Goldman-Segall (1990), said his classic line that young children learn to program and to think mathematically through becoming the turtle. Clearly, Papert was pointing toward what we are calling empathic embodiments.

In a more recent exploratory case study in a junior high school programming class, Kwah and Goldman (2011) observed, interviewed, and videotaped teacher gestures during instruction as well as both teacher and student gestures during problem-solving interactions. They found that "a teacher's gestures are flexible constructions that enable programming concepts to be visibly modeled from multiple perspectives" (p. 1). More interesting, given that gestures are visible actions, students shared (mirrored), as artifacts of embodied imagery, the teacher's gestures while explaining the same ideas to their peers. While Kwah and Goldman are not, from this exploratory study, generalizing that students' mirroring of teacher gestures increases learning, this research does indicate that gestures can serve as an aid for teachers to explain complex ideas of programming, which may not be as accessible to learners in more abstract ways. In short, understanding which gestures can promote understanding could become part of a cognitive toolkit for teachers that would benefit student learning.

In conclusion, although embodied interaction is the keystone activity in a multibillion-dollar gaming industry, sometimes called Body Movement-Controlled Video Games (BMCVGs), it is still little understood from a learning-sciences perspective, yet appears to promise rewarding design-based research into the nature of knowing, teaching, and learning.

PIONEERING LEARNING ENVIRONMENTS

In this age of Google, Facebook, Twitter, and a host of other social media environments, games for learning environments, and handheld smart devices to augment learning and create communities, it is difficult to select the *most* pioneering educational tools, as in, the ones that led to the kinds of tools and environments we use every day. Handheld computational devices are now ubiquitous and continually changing with each new "App." People of almost every age, socioeconomic, and ethnic background, country, and gender are texting, tweeting, and sharing private photos and videos. Websites and online tools are used continuously to share, promote, and flame. They have become part of the reality within which work, study, and play are mediated. On buses, subways, trains, planes, and while crossing city intersections, people are connecting with each other. If there is one thing the Arab Spring that first erupted in Tunisia on January 9, 2011—with protesters confronting the regime of President Zine el Abidine Ben Ali—taught us, it is that people have access to mobile handheld devices that are not only phones, but that also have the capacity to communicate instantly, create groups, and share images, text, and whatever else can be found somewhere on the web in seconds, engaging in a new form of public-centric journalism and curatorialship. The average person, with effort, can become a knowledge maker, a trendsetter, an investigator, and an expert who has curatorial power, if only over certain domains. A compelling personal narrative or story has become the vehicle for power, even political power as it is played out every day, not only by presidential hopefuls, but by leaders of repressive and violent groups.

At this time, the quality of learning with these social media devices is not easy to evaluate—the major critique being that the networked population is *distracting itself to death*, a play on the title of Neil Postman's book in 1985, *Amusing Ourselves to Death: Public Discourse in the Age of Show Business.* Other critiques are that multitasking, the method of moving around the various applications with different purposes, leads to shallow concentration and lack of focus. Others argue that the human mind is capable and ready for this kind of activity. That boredom is the real villain of learning. Others argue that social media, games, and surfing the web expand our ability to learn, help us keep in touch with communities and individuals, and promote new ways to socialize, find partners, and select friend recommended hotels, run businesses, and shop. There is some truth to both sides of each of these arguments, as one might expect. Early adopters are enthusiastic about what is coming down the pike and fall into each new device with few complaints. Luddites refuse to give up their vinyl albums and enjoy the time and space that the lack of constantly learning the next application affords. Added to those extremes, there is every shade between the two poles. More and more, parents, teachers, and users create methods to control time online and keep balance in the lives of their children and their own lives. In short, the jury is still out about the effectiveness of using social media as a learning device in spite of the fact that it seems like a seductive augmentation tool for accessing an infinite amount of information and fun.

The authors of this chapter now focus on the historical roots of these current digital media environments, making the case that the earlier software were precursors to social media and games for learning. This next section is a selection of some of the pioneering and perspectival technological systems developed to aid, enhance, and inspire learning and research using one or more elements of the Points of Viewing Theory. This montage is an authorial selection, not a representation of all pioneering systems for learning. It provides the reader with a snapshot of precursor tools rooted in the role of learners to build their own environments and become partners in the learning and research process.

LOGO

Logo, one of the oldest and most influential educational technology endeavors, dates back to 1967. Logo is a dialect of the AI research language LISP, and was developed by Wally Feurzig's team at BBN, working with Papert. This program made computer programming accessible to children, not through dumbing down computer science, but by carefully managing the relationship between abstract and concrete. Logo gave children the means to concretize mathematics and geometry via the computer, which made them into explorers in the field of math. As mentioned before, Papert believed that if the best way to learn French is not to go to French class, but rather to spend time in France, then the best way to learn mathematics would be in some sort of "Mathland" (Papert, 1980, p. 6). Logo provided a microworld operating in terms of mathematical and geometric ideas. By experimenting with controlling a programmable "turtle," children had direct, concrete experience of how mathematical and geometric constructs work. Through reflection on their experiments, they would then come to more formalized understandings of these constructs. Children became *epistemologists* thinking about their thinking about mathematics by living in and creating computer cultures.

With the growing availability of personal computers in the late 1970s and 1980s, the Logo turtle was moved onscreen, and the notion of the turtle in its abstract world called a *microworld,* a notion that has been the lasting legacy of the Logo research (Papert, 1980). The Logo movement was popular in schools in the 1980s, and versions of the language were developed for different computer systems. Some implementations of Logo departed from geometry microworlds, and were designed to address other goals, such as the teaching of computer programming (Harvey, 1997). Implementations of Logo are freely distributed on the Internet. See www.cs.berkeley.edu/∼bh/logo.html. The Logo Foundation at http://el.www.media.mit.edu/groups/logo-foundation/ has continued to expand the culture of Logo over the years.

Squeak

Squeak is the direct descendant of Alan Kay's Dynabook research at Xerox PARC; the Dynabook was conceived the 1970s. Squeak is a multimedia personal computing environment based on the SmallTalk object-oriented programming language that formed the basis of Kay's investigations into "personal" computing (Kay, 1996). It is notable in that it is freely distributed on the Internet, runs on almost every conceivable computing platform, and is entirely decomposable—while one can create new media tools and presentations as with other environments, one can also tinker with the underlying operation of the system—how windows appear, or how networking protocols are implemented. A small but enthusiastic user community supports and extends the Squeak environment, creating such tools as web browsers, music synthesizers, three-dimensional graphics toolkits, and so on entirely within Squeak. See www.squeak.org

Boxer

Boxer is a "computational medium"—a combination of a programming language, a microworld environment, and a set of libraries and tools for building tools for exploring problem solving with computers. Developed by diSessa, Boxer blends the Logo work of Papert (1980) and the "mutable medium" notion of Kay (1996) in a flexible computing toolkit. diSessa's work has been ongoing since the 1980s, when he conceived of an environment to extend the Logo research into a more robust and flexible environment in which to explore physics concepts (diSessa, 2000). Boxer is freely distributed on the Internet.

HyperCard

It is important to remember that in 1987, Apple Computer was exploring multimedia as the fundamental rationale for people wanting Macintosh computers. But, as there was little multimedia software available in the late 1980s, Apple decided to bundle a multimedia authoring toolkit with every Macintosh computer. This toolkit was *HyperCard,* and it proved to be enormously popular with a wide variety of users, and especially in schools. HyperCard emulates a sort of magical stack of 3 × 5 index cards, and its multimedia documents were thus called *stacks.* An author could add text, images, audio, and even video components to cards and then use a simple and elegant scripting language to tie these cards together or perform certain behaviors. Two broad categories of use emerged in HyperCard: the first was collecting and enjoying predesigned stacks; the second was *authoring* one's own. In the online bulletin board systems of the early 1990s, HyperCard authors exchanged great volumes of "stackware." Educators were some of the most enthusiastic users, either creating content for students (a stellar example of this is Apple's *Visual Almanac,* which married videodisc-based content with a HyperCard control interface) or encouraging students to create their own. Others used HyperCard to create scaffolds and tools for learners to use in their own media construction. A good snapshot of this HyperCard authoring culture is described in Ambron and Hooper's *Learning with Interactive Multimedia* (1990). HyperCard development at Apple languished in the mid-1990s and disappeared in the 2000s.

Constellations/WebConstellations/Orion 1.0/Orion 2.0

Building on the HyperCard platform, Learning Constellations (Goldman-Segall, 1989) was a collaborative video annotation tool that builds on the metaphor of stars (video chunks) and constellations (collections). Star video chunks could be combined to make constellations, but *different users may place the same star in different contexts, depending on their understanding by viewing data from various perspectives.* Learning Constellations was a data-sharing system, promoting Goldman-Segall's notion of configurational validity by allowing different users to compare and exchange views on how they contextualize the same information differently in order to reach valid conclusions about the data (Goldman-Segall, 1995; Goldman-Segall & Rao, 1998). It also features collaborative ranking and annotation of data nodes. While other video analysis tools were developed in the 1980s and early 1990s (Harrison & Baecker, 1992; Kennedy, 1989; Mackay, 1989; Roschelle, Pea, & Trigg, 1990), Learning Constellations (aka Constellations) was the first video data analysis tool to analyze a robust video ethnographic data (Goldman-Segall, 1989, 1990, 1991).

Continuing to use the HyperCard plaftorm, Goldman-Segall developed a updated version of Learning Constellations as a stand-alone application in 1993. She added a *significance measure* to layer descriptions and "rate attributes" the themes and keywords (Goldman-Segall, 1993). In 1998, the tool went online as a web-based collaborative video analysis tool called WebConstellations (Goldman-Segall, 1998c, 1999; Goldman-Segall & Rao, 1998). Every media type—website page, text document, video chunk, or photo could become a star chunk and could be tagged, rated, and juxtaposed for comparative analysis. The most recent version, Orion 2.0 returned back to its original functionality of being a tool only video chunking, sorting, analysis, ethnographic theory-building and story-making. As a perspectivity technology, individuals enter into Orion, creating their own home page and inviting others to join in the analysis. Taking a lead in feature development, by 2007 each user could have a number of simultaneous projects with diverse research communities, in somewhat the same way that social media now enables groups to work.

Adventures of Jasper Woodbury

Jasper Woodbury is the name of a character in a series of adventure stories that the (CGTV) use as the basis for "anchored instruction." The stories, presented on videodisc or CD-ROM are carefully crafted mysteries that present problems to be solved by groups of learners. Since the video can be randomly accessed, learners are encouraged to re-explore parts of the story in order to gather clues and develop theories about the problem to be solved. The Jasper series first appeared in the 1980s and there are now 12 stories (Cognition and Technology Group at Vanderbilt University, 1997).

CSILE/Knowledge Forum

CSILE—Computer Supported Intentional Learning Environment—was developed by Marlene Scardamalia and Carl Bereiter at the Ontario Institute for Studies in Education (OISE) in the 1980s. CSILE is a collaborative, problem-based, knowledge-building environment. Learners can collaborate on data collection, analysis of findings, constructing and presenting conclusions by exchanging structured "notes," and attaching further questions, contributions, and so on to preexisting notes. CSILE was originally conceived to provide a dynamic scaffold for knowledge construction—one that would let the learners themselves direct the inquiry process (Scardamalia & Bereiter, 1991). CSILE is now commercially developed and licensed as *Knowledge Forum.*

StarLogo and NetLogo

StarLogo and NetLogo are parallel-computing versions of Logo. By manipulating multiple (thousands), distributed "turtles," learners can work with interactive models of complex interactions, population dynamics, and other decentralized systems. Developed by Mitchel Resnick, Uri Wilensky and a team of researchers at MIT, StarLogo was conceived as a tool to move learners' thinking "beyond the centralized mind-set" and to study how people make sense of complex systems (Resnick, 1991, 1994; Wilensky & Resnick, 1999). NetLogo—an environment developed by Wilensky at the Center for Connected Learning and Computer-Based Modeling at Northwestern University is in widespread use both in education and research. Both of these are freely available on the Internet. See http://ccl.northwestern.edu/netlogo/ and www.media.mit.edu/starlogo.

MaMaMedia/World Wide Workshop

The World Wide Workshop is a global foundation for developing open-source applications of social media technology and game production, to enhance learning, innovation, entrepreneurship, and an understanding of the world in economically disadvantaged and technologically underserved communities (www.worldwideworkshop.org).

An organization founded in 2004 by MIT Media Lab graduate and entrepreneur Idit Harel, World Wide Workshop addresses the problem of closing the digital divide and transforming education by reaching low socioeconomic youth in low-performing schools with learning networks and by taking a systemic approach to education innovation and reform. In 2006, the World Wide Workshop launched the Globaloria Learning Network (www.Globaloria.org). The Globaloria Learning Network (www.Globaloria.org) is a "blended learning lab" that provides a year-long digital curriculum, tools, resources, student and educator data tracking, and professional development for educators to engage, motivate, and advance students' STEM learning through game design. Young people in middle school and high school ages are immersed in blended learning (combining online and on-site), becoming game designers and mastering creative computational skills and core content knowledge. Academic researchers from several countries work with the World Wide Workshop to study constructionist digital literacy, motivation and engagement, and how new technology innovation can inform, engage, and transform students, teachers, schools, and communities.

The underlying constructionist digital literacy approach stems from her MIT Media Lab research and was also present in an earlier company Harel founded in the 1990s called MaMaMedia. The rationale of MaMaMedia was to enable kids and their parents to participate in web experiences that are creative, safe, constructionist by nature, and educational. Harel's book, *Children Designers* (Harel, 1991), lays the foundation for MaMaMedia, and for research in understanding how children in rich online environments construct software and design math games with representations of their thinking. MaMaMedia enabled girls and boys to be online playing games, learning how to participate in the vast MaMaMedia community.

MOOSE Crossing

Georgia Tech researcher Amy Bruckman created *MOOSE Crossing* as part of her doctoral work at the MIT Media Lab. MOOSE Crossing can be characterized as a breakthrough combination of Papert's Logo/microworlds, the "mutable media" notions of Alan Kay (Kay, 1996), and a MOO (Haynes & Holmevik, 1998)—a real-time, collaborative, immersive virtual environment. MOOSE Crossing is a microworld that learners can themselves enter, designing and programming the virtual environment from within. It becomes a lived-in text that one shares with other readers/writers/designers. Bruckman (1998) stated that this early innovation, MOOSE Crossing, was "community support for constructionist learning." Indeed, it was.

> Calling a software system a place gives users a radically different set of expectations. People are familiar with a wide variety of types of places, and have a sense of what to do there . . . Instead of asking What do I do with this software?, people ask themselves, What do I do in this place? The second question has a very different set of answers than the first. (Bruckman, 1998, p. 49)

Bruckman's thesis is that community and constructionist learning go hand in hand. Her ethnographic accounts of learners inside the environment reveals very close, very personal bonds emerging between children in the process of designing and building their world in MOOSE Crossing. "The emotional support," she writes, "is inseparable from the technical support. Receiving help from someone you would tell your secret nickname to is clearly very different from receiving help from a computer program or a schoolteacher" (p. 128).

SimCalc

SimCalc's tagline is "Democratizing Access to the Mathematics of Change," and the goal is to make the understanding of change accessible to more learners than the small minority who take calculus classes. SimCalc, a project at the University of Massachusetts under James Kaput working with Jeremy Roschelle, and Ricardo Nemirovky, is a simulation and visualization system for learners to explore calculus concepts in a problem-based model, one that avoids traditional problems with mathematical representation (Kaput, Roschelle, & Stroup, 1998). The core software, called *MathWorlds* (echoing Papert's "Mathland" idea) allows learners to manipulate variables and see results via real- time visualizations with both animated characters and more traditional graphs. SimCalc is freely available on the Internet. See www.simcalc.umassd.edu/

Participatory Sims

Participatory Sims, a project overseen by Uri Wilensky and Walter Stroup at Northwestern University, is a distributed computing environment built on the foundations of LOGO that encourages learners to collaboratively explore complex simulations. The Participatory Sims project centers on HubNet, a "Classroom-based Network of Handheld Devices and Up-front Computer," which allows learners to participate in models of dynamic systems (Resnick, 1996) in a live, classroom environment. "The emergent behavior . . . of the system and its relation to individual participant actions and strategies can then become the object of collective discussion and analysis" (Wilensky & Stroup, 1999). See www.ccl.sesp.northwestern.edu/ps/index.html

CoVis

CoVis—"Collaborative Visualization"—a project that ran from Northwestern University in the 1990s, was clearly a strong predictor of what was to follow in education. It focused on science learning through projects using a telecommunications infrastructure, scientific visualization tools, and software to support collaboration between diverse schools in distributed locations (Edelson et al., 1996). Much of learners' investigation centered on atmospheric and environmental studies, allowing wide-scale (across the United States) data sharing. Learners could then use sophisticated data analysis tools to visualize and draw conclusions. CoVis made use of a variety of networked software: collaborative "notebooks," distributed databases, system visualization tools, as well as the WWW and electronic mail. The goal in the CoVis project was for young people to study topics in much the same way as professional scientists do.

National Geographic Kids Network

Another example of an early perspectivity environment in the late 1980s and 1990s was the National Geographic Kids Network. A number of very large-scale research projects explored the possibilities of connecting multiple classrooms across the United States for data sharing and collaborative inquiry (Feldman et al., 2000). Programs like *National Geographic Kids Network* (NGKNet), an NSF-funded collaboration between the National Geographic Society and educational technology research center TERC reached thousands of classrooms and tens of thousands of students (p. 30). TERC's NGKNet provided curriculum plans and resources around issues like acid rain, and tools, which facilitated large-scale data collection, sharing, and analysis of results. Other projects, like *Classroom BirdWatch* and *EnergyNet*, focused on issues with comparable global significance and local implications, turning large numbers of learners into a community of practice doing distributed scientific investigation. Feldman, Konold, and Coulter note that these large-scale projects question the notion of the individual child as scientist, pointing instead toward interesting models of collaborative engagement in science, technology, and society issues (pp. 142–143). Needless to say this work still continues to impress. See http://kids.nationalgeographic.com/kids/

Tapped In

Tapped In is a Multi-User Online Educational Workspace (MEOW) for teachers and education professionals. The Tapped In project, led by Mark Schlager at SRI, began in the late 1990s as a MOO (textual VR) environment for synchronous collaboration and has since grown into a sophisticated (Web + MOO) multimedia environment for both synchronous and asynchronous work, with a large and active user population (Schlager & Schank, 1997). Tapped In uses similar technological infrastructure to MOOSE Crossing, but has a different kind of community of practice at work within it; Tapped In functions more like an ongoing teaching conference, with many weekly or monthly events, workshops, and happenings. Tapped In is an exemplary model of a multimode collaborative environment. See www.tappedin.sri.com/

CoWeb

At Georgia Tech, Mark Guzdial and colleagues at the Collaborative Software Laboratory (CSL) created a variety of software environments building on the original educational computing vision of Alan Kay in the 1970s (Kay, 1996); the computer can be a tool for composing and experiencing dynamic media. Growing from Guzdial's previous work on the *CaMILE* project (Guzdial, 1997)—a web-based "anchored collaboration" environment, CSL's *CoWeb* project explores possibilities in designing and using collaborative media tools online (Guzdial, 1999). CoWeb and other CSL work is largely based on the *Squeak* environment, a direct descendant of Alan Kay's research at Xerox PARC in the 1970s.

WebGuide

WebGuide, a web-based, collaborative knowledge-construction tool, was created by Gerry Stahl and colleagues at the University of Colorado (Stahl, 1999). WebGuide is designed to facilitate personal and collaborative understanding through mediating perspectivity via cultural artifacts. WebGuide acts as a scaffold for group understanding. WebGuide is a structured conferencing system supporting rich interlinking and information reuse/recontextualization, as well as multiple views on the structure of the information set. Learners contribute information from individual perspectives, but this information can later be negotiated and re-collected in multiple contexts construct.

CHALLENGING QUESTIONS

Models of Mind or Culture Creation?

From the vantage point of the mid-1990s, Jerome Bruner looked back on the cognitive revolution of the late 1950s, which he helped to shape, and reflected on a lost opportunity. Bruner had imagined that the new cognitive paradigm would bring the search for meaning to the fore, distinguishing it from the behaviorism that preceded it (Bruner, 1990, p. 2). And yet, Bruner writes, the revolution went awry, not because it failed, but because it succeeded:

> Very early on, for example, emphasis began shifting from "meaning" to "information," from the *construction* of meaning to the *processing* of information. These are profoundly different matters. The key factor in the shift was the introduction of computation as the ruling metaphor and computability as a necessary criterion of a good theoretical model. (p. 4)

The information-processing model of cognition became so dominant, Bruner argues, and the role of meaning and meaning-making ended up as much in disfavor as it had been in behaviorism. "In place of stimuli and responses, there was input and output," and hard empiricism ruled again, with a new vocabulary, but with the same disdain for mentalism (p. 7).

Bruner's career as a theorist is itself instructive. Heralded by Gardner and others as one of the leading lights of 1950s cognitivism, Bruner has since the 1980s been one of a small but vocal group calling for a return to the role of culture in understanding the mind. This movement has been tangled up closely with the evolution of educational technology over the same period, perhaps illuminated in a pair of titles that bookend one researcher's decade-long trajectory: Etienne Wenger's (1987) *Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge* and his (1998) *Communities of Practice: Learning, Meaning, and Identity*.

Paradigm Shift With Digital Media or Incremental Changes?

In his 1996 article, "Paradigm Shifts and Instructional Technology: An Introduction," Timothy Koschmann began by identifying four defining paradigms of technology in education. In roughly chronological (but certainly overlapping) order, these are: Computer-Aided Instruction (CAI), characterized by drill-and-practice and programmed instruction systems; Intelligent Tutoring Systems (ITS), which drew on artificial intelligence (AI) research in order to create automated systems, which could evaluate a learner's progress and tailor instruction accordingly; the Logo-as-Latin paradigm, led by Seymour Papert's "microworld" and children-as-programmers efforts; and finally, Computer-Supported Collaborative Learning (CSCL), a "socially oriented, constructivist" approach that focuses on learners in practice, in groups. Koschmann invoked Thomas Kuhn's (1996) controversial notion of the *incommensurability* of competing paradigms:

> Kuhn held that the effect of a paradigm shift is to produce a divided community of researchers no longer able to debate their respective positions, owing to fundamental differences in terminology, conceptual frameworks, and views on what constitutes the legitimate questions of science. (Koschmann, 1996, p. 2)

Koschmann's analysis may well be accurate. The literature surrounding the effects learning technology produces certainly displays examples of this incommensurability, even within the writings of individual theorists.

A counter perspective to Kuhn's view of paradigmatic shifts in scientific understanding was offered by Stephen Toulmin (1972), who argued that conceptual change must not be understood as a globally unified, systematic shift in attitudes in beliefs about science; rather, it was a fragmented process, which was highly contextualized and dependent on local scientific practices. According to Toulmin, knowledge develops in a more piecemeal fashion rather than through seismic leaps; 'competing' paradigms continue to exert considerable influence on our understanding. Andrea diSessa (2006), arguing for a reappraisal of Toulmin's neglected work on conceptual change, applied it to how the "intuitive ideas" that young learners brought to a physics lesson were crucial resources for developing "knowledge in pieces," or the weaving of various threads of ideas into a "different, stronger, and more normative conceptual fabric" (diSessa, 2006, p. 273). The application of these ideas to learning technologies casts doubt upon the notions of internal coherence of individual paradigms and their representative designers, as well as their impermeability to each other.

As mentioned earlier, Papert's work with teaching children to program in Logo was originally concerned with bridging the gap between Piaget's concrete and formal thinking stages, particularly with respect to mathematics and geometry. But over time, Papert's work with children and Logo began to be talked about as "computer cultures" (Papert, 1980, pp. 22–23): Logo gave its practitioners a vocabulary, a framework, and a set of tools for a particular kind of learning through exploration. Papert envisaged a computer culture where children could express themselves as epistemologists, challenging the nature of established knowledge. But while Papert's ideas and the practice of Logo learning in classrooms contributed significantly to the *esprit de temps* of the 1980s, it was difficult for many mainstream educational researchers and practitioners to adopt the mindset he believed would revolutionize learning.

A large-scale research project to evaluate the claims of Logo in classrooms was undertaken by researcher Roy Pea (when he was at Bank Street College) and his colleagues in the mid-1980s. The Bank Street studies came to some critical conclusions about the work Papert and his colleagues were doing (Pea & Kurland, 1987 [1984]; Pea, Kurland, & Hawkins, 1987; Pea, 1987). Basically, the Bank Street studies concluded with a cautious note: They concluded that no significant effects on cognitive development could be confirmed, and called for much more extensive and rigorous research amid the excitement and hype. The wider effect of the Bank Street publications fed into something of a popular backlash against Logo in the schools. A 1984 article in the magazine, *Popular Psychology* summarized the Bank Street studies, and suggested bluntly that Logo had not delivered on Papert's promises.

Papert responded to this critique (Papert, 1987 [1985]), arguing that the framing of research questions was overly simplistic. Papert chided his critics for looking for cognitive effects by isolating variables as if classrooms were "treatment" studies. Rather than asking "technocentric" questions like "What is THE effect of THE computer?" (p. 23), Papert called for an examination of the culture-building implications of Logo practice, and for something he called *computer criticism,* which he proposed as akin to literary criticism.

Pea and others responded (1987b), claiming that Papert had unfairly characterized the Bank Street research (Papert had responded only to the *Psychology Today* article, not to the original literature), and arguing that as researchers they had a responsibility to adhere to accepted scientific methods for evaluating the claims of new technology. The effect of this exchange was to illuminate the vastly different perspectives of these researchers. Where Papert was talking about the open-ended promise of computer cultures, Pea and his colleagues, developmental psychologists, were evaluating the work from the standpoint of demonstrable changes in cognition (Pea & Kurland, 1987 [1984]). While Papert accused his critics of reductionism, Davy (1985) likened Papert to the proverbial man who looks for his keys under the streetlight "because the light is better there."

Gavriel Salomon and Howard Gardner responded to this debate with an article that searched for middle ground (Salomon & Gardner, 1986): An analogy, they pointed out, could be drawn from research into television and mass media, a much older pursuit than educational computing, and one in which Salomon was an acclaimed scholar. Salomon and Gardner argued that one could not search for independent variables in such a complex area; instead, they called for a more holistic, exploratory research program, one that took more than the overt *effects of* the technology into account.

Indeed, in 1991, Salomon and colleagues David Perkins and Tamar Globerson published a groundbreaking article that shed more light on the issue (Salomon et al., 1991). To consider the "effects of" a technology, one had to consider what was changed after a learner had used a technology—but in the absence of it. The questions that arise from this are whether there is any "cognitive residue" from the prior experience, and whether there is transfer between tasks. This is a different set of questions than arise from investigating the "effects with" technology, which demand a more decentered, system-wide approach, looking at the learner in *partnership* with technology.

While it contributed important new constructs and vocabulary to the issue, the Salomon, Perkins, and Globerson article is still deeply rooted in a traditional cognitive science perspective, like much of Pea's research, taking first the individual mind as the site of cognition. Salomon, Perkins, and Globerson, all trained in cognitive psychology, warn against taking the "effects with" approach too far, noting that computers in education are still far from ubiquitous, and that the search for the "effects of" is still key. From the perspective of today's ubiquitous computing technologies, which have taken the "effects with" study of technology "out of the lab," and into countless informal settings, a less rigid cognitive orientation is now the norm for understanding technology's diffuse, yet constitutive effects on human interaction and community building. The most visible example is the revolution in online social networks, online game play, and social media in general.

In a 1993 article, Pea responded to Salomon et al. (1991) from yet a different angle. Pea, now dean at Northwestern and working closely with his Learning Sciences colleagues, wrote on "distributed intelligence," and argued against taking the individual mind as the locus of cognition, criticizing Salomon and colleagues' individualist notions of cognitive residue:

> The language used by Salomon et al. (1991) to characterize the concepts involved in how they think about distributed intelligence is, by contrast, entity-oriented—a language of containers holding things. (Pea, 1993, p. 79)

Pea, reviewing literature on situated learning by Brown et al. (1996 [1980]), Lave (1988), Wenger and Lave (1991), Greeno (1997), and by Winograd and Flores (1986), changed from the standard individualist framework of cognitive science to a more "situative perspective," while Salomon (1993) maintained that cognition must reside in the individual mind. Neither Salomon nor Pea in this exchange were comfortable with the notion of culture-making as a "contributing factor" to mind, artifacts, and such empirically identifiable constructs. However, Pea's work on distributed cognition had a great impact on future studies on cognition in the context of emerging media technologies.

The question needs to be asked: Are these advances made with the introduction of digital media technologies representative of a paradigm shift or are they merely a conversation among differing points of viewing, based on different measures and methods of studying the problem? Indeed, it seems that the proof is in the pudding. A cultural shift has occcured. The next step is to harness the scholarship to create a vision for seriously changing how learning can be re-created with more engagement and involvement with all the stakeholders. In other words, to be able to find the patterns in current research so that less time is spent on debates and more on reaching agreements.

Developmental or Narrative Appoaches to Learning Theory?

Understanding the nature of technology-based learning systems greatly depends on one's conceptualization of how learning occurs; is learning linear and developmental, or a more fluid and even random "system" of making meaning of experience?

Proponents of stage theory have tried to show how maturation takes place in logical causal sequences or stages according to observable stages in growth patterns—the final stage being the highest and most coveted. Developmental theories, such as Freud's oral, anal, and genital (Freud, 1952); Erikson's eight stages of psychological growth from basic trust to generativity (Erikson, 1950); or Piaget's stages from sensori-motor to formal operational thinking (see Grubner & Voneche, 1977), are based on the belief that the human organism must pass through these stages at critical periods in its development in order to reach full healthy integrated maturation, be it psychological, physical, spiritual, or intellectual.

Strict adherence to developmentalism, particularly its unidirectional conception, has been significantly challenged by Gilligan (1982), Gardner (1985), Fox Keller (1983), and Papert (1980), not to mention a wave of postmodern theorists—proposing theories that address the fundamental issues underlying how we come to terms with understanding our thinking. One such challenge, raised by Ivan Illich and Barry Sanders (1988), reflects on the prehistorical significance of the narrative voice. Thinking about thinking as essentially evolving stages of development requires the kind of calibration only possible in a world of static rules and universal truths. They point out that narrative thinking is rather a weaving of different layers or versions of stories that defy developmentalism. Narratives are never fixed in time or place. Before the written word and

> [p]rior to history . . . there is a narrative that unfolds, not in accordance with the rules of art and knowledge, but out of divine enthusiasm and deep emotion. Corresponding to this prior time is a different truth—namely, myth. In this truly oral culture, before phonetic writing, there can be no words and therefore no text, no original, to which tradition can refer, no subject matter that can be passed on. A new rendering is never just a new version, but always a new song. (p. 4)

Illich and Sanders contend that the prehistoric mode of thinking was a relativistic experience—that what was expressed at any given moment in time changed from the previous time it was expressed. There could be no fixed recall, nor truth as we define it today. This concept of knowledge as a continually changing truth, dependent on both communal interpretation and storytellers' innovation, dramatically changed with the introduction of writing. The moment a story could be written down, it could be referred to. Memory changed from being an image of a former indivisible time to being a method of retrieving a fixed, repeatable piece or section of an experience. In other words, narrative intelligence is not acquired developmentally in stages, but rather, phenomenologically and emotionally, through experience.

The development of prehistoric thinking (with image and imagination) through historical thinking (with writing and conceptual schemes) has also been called *posthistorical thinking* (Flusser, 2004). Beginning with photography and on through networked computing devices, new image-based media, while born in conceptual thought, has enabled learners to tap into their "imaginal capacity" to reflect on their own learning processes and redefine the world through multiple representations of knowledge, also changing the notion of a fixed truth.

Another notion to Illich and Sanders emerges in Carol Gilligan's research on gender and moral development (1982). Gilligan makes the case that the "different voice" women bring includes an ethic of care, a tie between relationship and responsibility (1982, p. 173). Gilligan set the stage for a new mode of research, which includes intimacy and relationship rather than separation and objectivity, the tenets of traditional empiricism.

Evelyn Fox Keller, a leading critic of the masculinization of science, heralded the relational model as a legitimate alternative for doing science. She pointed out that science is a deeply personal as well as a social activity (1985), historically preferential to a male and objectivist manner of thinking. Combining Thomas Kuhn's ideas about the nature of scientific thinking with Freud's analysis of the different relationship between young boys and their mothers and between girls and their mothers, Fox Keller analyzed underlying reasons for scientific objectivism. She claimed that boys are encouraged to separate from their mothers, and girls to maintain attachments, influencing the manner in which the two genders relate to physical objects. The young boy, in competition with his father for his mother's attentions, learns to compete in order to succeed. Girls, not having to separate from their mothers, find that becoming personally involved—getting *a feeling for the organism,* as Barbara McClintock (Fox Keller, 1985) would say—is a preferred mode of making sense of their relationship with the physical world. As a result, girls may do science in a more connected style, seeking relationships with, rather than dissecting, what they investigate. Girls seek to understand meaning through these personal attachments.

> Just as science is not the purely cognitive endeavor we once thought it, neither is it as impersonal as we thought: science is a deeply personal as well as a social activity. (1985, p. 7)

Obviously, we will never know if a scientific discipline would really be different if it had been driven by more relational or narrative influences. Yet we may want to ask how people with a tendency toward relational or narrative thinking can be both invited into the study of the sciences and be encouraged to contribute to its theoretical foundations. And, we may want to ask how new media and technologies expand how we study what we study, thereby inviting a range of epistemologically diverse thinkers into the mainstream of intellectual pursuits.

Bricolage and/or the Ecology of Digital Media Technologies

In her first book, *The Second Self: Computers and the Human Spirit* (1984), Sherry Turkle explored the different styles of mastery that she observed in boys and girls in Logo classrooms. Returning to this topic, Turkle and Papert, in their 1991 article, "Epistemological Pluralism and the Revaluation of the Concrete," outline two poles of technological mastery: hard and soft. Hard mastery, identified with top-down, rationalist thinking, was observed in a majority of boys. Soft mastery, identified with relational thinking and Claude Lévi-Strauss's notion of *bricolage,* was observed in a majority of girls working with computers in a Boston elementary school (Turkle & Papert, 1991, pp. 167–168). The identification of soft mastery and *bricolage* in programming was a turning point that led to a deeper examination of "the concrete," a subject woefully undervalued in contemporary life, and especially in math and science education.

Stanford scholar Brigid Barron (2006) found that "Learners use strategies consistent with the bricoleur image described by Turkle, building on the concept introduced by Levi-Strauss [1966] where information is flexibly gathered and put together for new purposes." Barron revisited the role of the bricoleur to expand on what Nardi and O'Day (1999) call *information ecologies.* Not only are information ecologies a product of both relational and material resources as Nardi and O'Day suggest, but also, according to Barron, dynamic learning systems include a range of multiple influences that dovetail well with understanding learning in formal and informal learning settings. She concludes with a call for changes.

> The reports from the young learners shared . . . suggest that we should expect interest in learning to originate within and outside school and that adolescents have a significant role to play in sustaining their own development. As researchers interested in human development, we are in a vital position to help envision what self-sustaining learning ecologies might look like and investigate how resourcefulness might be nurtured. (Barron, 2006, p. 221)

Turkle and Papert's use of the term *bricoleur* and the notion of *hard* and *soft* to explain different approaches to computation extends to other important domains: ecological stances, feminism, and ethnography of science and computation (1991, p. 372). They propose that hard and soft styles of creating knowledge and understanding systems as equally significant to concrete thinking will gain respectability in the scientific community by attending more to the "softer" concrete way of thinking.

> The development of a new computer culture would require more than technological progress and more than environments where there is permission to work with highly personal approaches. It would require a new and softer construction of the technological, with a new set of intellectual and emotional values more like those we apply to harpsichords than hammers. (Barron, 2006, p. 184)

Goldman-Segall offered a dynamic and flexible conceptualization of diversity of thinking called *thinking attitudes* (Goldman-Segall, 2008). These attitudes imply positionality and orientation, and are situated in time and place. She defined thinking attitudes as a transitional position held for a shorter period of time, one that is fluid and flexible (p. 245). This notion of *thinking attitudes* includes: meta/physical, historical, ethical, and pedagogical attitudes. Meta/physical attitudes address the question, "What's the story?" They explore how children address causality, intention, existence, and truth. The meta/physical attitudes in adolescents are turning points, referring to the worlds of invention and imagination—attitudes that are rooted in the physical situatedness of their interactions with the world. Historical attitudes address how things began. They encompass learning from the past and making sense of it. Ethical attitudes include our actions in relation to desire and external norms. Balancing right and wrong is particularly challenging. These attitudes address questions such as: "What is fair?" To a great extent, pedagogical (or activist) attitudes overlap with ethical attitudes. Pedagogical attitudes are concerned with such questions as "What can we do? How do we change? How do we teach others to learn from what we did?" (Video excerpts are available on the web: www.pointsofviewing.com.)

This dynamic epistemological theory of learning led to ways of knowing that include *genderflexing*: Boys may take on *thinking attitudes* that are traditionally associated with those of girls, and vice versa (Goldman-Segall, 1996b, 1998a, 1998c). The underlying theme here is the primacy of situated points of viewing, rather than essential qualities. Learners become ethnographers, observing and engaging with the cultural environments in which they participate. She also recommends *knowledge framing* (1998). Framing is rooted in several diverse but interwoven contexts: Frames—in contrast to the more essentialist notion of styles—include the context set by the framer, what is framed, as well as what is left out of the frame. In other words, for learning, it is more important to have flexible thinking attitudes about the content knowledge so that the frames that are applied to that cluster of knowledge are appropriate and useful in understanding the domain under investigation. Related uses of framing can be found in the work by Marvin Minsky on artificial intelligence (1986), Howard Gardner on multiple intelligences (1985), Erving Goffman on everyday sociology (1986), and Trinh Minh T. Ha on cinematography (1992).

Distributed Cognition and Situated Learning

Over the next decade, the focus had changed from understanding the mind of one child to understanding the situated minds of learners in collaborative teams. Simultaneously, learning environment theories moved to social constructionism, to problem-based learning (PBL) environments spearheaded by Cindy Hmelo-Silver and Howard Barrows (2006), as well as to rich-media cases of teaching practices.

The 1989 article by John Seely Brown, Alan Collins, and Paul Duguid called "Situated Cognition and the Culture of Learning" (1996 [1989]) is generally credited with introducing the concepts and vocabulary of situated cognition to the educational community. This influential article, drawing on research at Xerox PARC and at the Institute for Research on Learning (IRL), expressed the authors' concern with the limits to which conceptual knowledge can be abstracted from the situations in which it is situated and learned (p. 19), as is common practice in classrooms. Building upon the experiential emphasis of pragmatist thinkers like John Dewey and on the social contexts of learning of Russian activity theorists like Vygotsky and Leontiev, Brown and his colleagues proposed the notion of *cognitive apprenticeship*. In a cognitive apprenticeship model, knowledge and learning are seen as situated in practice: "Situations might be said to co-produce knowledge through activity. Learning and cognition, it is now possible to argue, are fundamentally situated" (p. 20). This idea is carried forward to an examination of tools and the way in which they are learned and used:

> Learning how to use a tool involves far more than can be accounted for in any set of explicit rules. The occasions and conditions for use arise directly out of the context of activities of each community that uses the tool, framed by the way members of each community see the world. The community and its viewpoint, quite as much as the tool itself, determine how a tool is used. (Brown et al., 1996 [1989], p. 23)

The work that brings the situated perspective firmly home to the learning environment is Jean Lave and Etienne Wenger's *Situated Learning: Legitimate Peripheral Participation* (1991), which goes significantly beyond Brown's cognitive apprenticeship model. Core to Lave and Wenger's work is the idea of knowledge as distributed or stretched across a community of practice—what Salomon later called the "radical situated perspective" (Salomon, 1993).

> In our view, learning is not merely situated in practice—as if it were some independently reifiable process that just happened to be located somewhere; learning is an integral part of generative social practice in the lived-in world . . . Legitimate peripheral participation is proposed as a descriptor of engagement in social practice that entails learning as an integral constituent. (Lave & Wenger, 1991, p. 35)

This perspective flips the argument over: It is not that learning happens best when it is situated (as if there were learning settings that aren't situated), but rather, learning is an integral part of all situated practice. So, rather than asking—as Bransford and colleagues at Vanderbilt had—"How can we create authentic learning situations?" they ask "What is the nature of communities of practice?" and "How do newcomers and old-timers relate and interact within communities of practice?" Lave and Wenger answer these questions through elaborating on the nature of communities of practice in what they term *legitimate peripheral participation*.

> By this we mean to draw attention to the point that learners inevitably participate in communities of practitioners and that mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community. (p. 29)

Lave and Wenger also elaborate on the involvement of cultural artifacts and technologies within communities of practice. As knowledge is stretched over a community of practice, it is also embodied in the material culture of that community, both in the mechanisms of practice and in the shared history of the community:

> Participation involving technology is especially significant because the artifacts used within a cultural practice carry a substantial portion of that practice's heritage . . . Thus, understanding the technology of practice is more than learning to use tools; it is a way to connect with the history of the practice and to participate more directly in cultural life. (p. 101)

Artifacts and technology are not just instrumental in embodying practice; they also help constitute the structure of the community. As Goldman-Segall, in her 1998a book, *Points of Viewing Children's Thinking: A Digital Ethnographer's Journey*, reminds us,

> The [tools we now have] are not just tools used by our culture; they are tools used for making culture. They are partners that have their own contribution to make with regard to how we build a cultural understanding of the world around us . . . . Readers of our socially constructed texts can either be silent lurkers or decide to make their presence known to us. Layers build. Patterns emerge, friendships or enmities grow, and digital inquiry becomes a reflexive practice—with an emphasis on flexing, stretching, and strengthening our inquiry. (pp. 268–269)

Situated cognition, then, becomes perspectival knowledge, and the tools and artifacts we create become what Goldman coined "perspectivity technologies": viewpoints, frames, lenses, and filters; reflections of selves with others. To understand the significance of perspectivity in the role of learning, one has to turn to recent studies on the other side of the coin—perception. This renewed interest in perceptually grounded research, or embodiment, encompasses the continually interacting parts of making meaning.

CONCLUSION

In this chapter, the Points of Viewing Theory was applied to an already rich understanding of the use of computers, the Internet, and digital media. The range of possible contributors was so broad that we decided to focus only on those theories and tools that were directly connected with the notion of perspectival knowledge construction and perspectivity technologies. To those researchers whose work is not described in this chapter, we regret that we did not find the opportunity to include your work.

Perspectivity technologies (Goldman, 2007) represent the next phase of thinking with our technology partners. Not only will we build them, shape them, and use them. They will also affect, influence, and shape us. They will become, if some researchers have their way, part of our bodies, not only augmenting our relationships but becoming members in their own right. As robotic objects become *robotic subjects,* we will have to consider how Steven Spielberg's robot in the movie *AI* felt when interacting with humans—and hopefully, we will be kinder to ourselves and to our robots.

Thus, a perspectivity technology is not only a technology that enables us to better see each other's viewpoints and make decisions based on multiple points of viewing. It is also concerned with the creation and design of technologies that add perspectives. Technologies have built-in filters. To explain this briefly, one need only think of how recording an event with pen and paper, an audiotape recorder, and a digital video recorder each provide different perspectives of the same event. The technology provides an important filter or lens. A viewpoint, one could say. And although that viewpoint is deeply influenced by who the filmmaker is, or who the reporter is, there is a perspective that is contributed by the technology. A camera tells a different story than the audio or text tool.

As we use new media as communication devices, these tools affect how we communicate; they participate by being what they are, and by having a capacity to shape the story. Beyond the *media is the message* theme of Marshall McLuhan (1964), we are now deeply entrenched in a participatory relationship with our new media technologies because they have become part of our perspective, our consciousness, and our way of life. The level of interaction with our virtual creatures (technologies) transforms our relationships. We are never completely alone. We are connected through media devices even if we cannot see them. They see us.

That said, what has changed in learning? It might seem we have moved a long way from believing that learning is putting certain curriculum inside of students' heads and then testing them for how well they have learned that material. Yet, instructionism is still alive and well. From kindergarten to higher education, students are still being trained to be able to pass tests that will provide them with entrance into higher education. In spite of learning theories moving from behaviorism to cognitivism to distributed and situated cognition, educators are caught in the quagmire of preparing students for their future education instead of trying to make the present educational, engaging, challenging, and fun. Teachers are caught in an entangled web of uncertainty as they scramble to learn the new tools of the trade (the Internet, distance learning environments, etc.), learn the content they have to teach, and then organize the learning into modules that will fit into the next set of learning modules.

The irony is that when we think of who our best teachers were, they were the ones who were able to elicit something within us and help us connect our lives to others' lives. Not a technology thing! The lives of poets, mathematicians, physicists, and the fisher down at the docks. These teachers created a sense of community in the classroom. We became part of a discovery process that had no end. Ideas came together that had not yet been put together—at least in our own minds. We felt we invented something new. And indeed we and others within these learning environments did invent new ideas in our minds. Yet, people say that this cannot happen to most students in most classes and the best we can do is to teach the curriculum, provide a safe learning environment, and test people for what we wanted them to learn. This is not good enough. And if students do not become partners in their learning now, technologies will create islands of despair as more and more students stop learning how to be creative citizens interested in each other, in making a difference, and in understanding complexity. And technology could open up a gulf between people as well as a lack of boundaries between work and play. In Sherry Turkle's book, *Alone Together* (2011), she explores these problematics of computer use reminding us about a serious problem facing a technologically seduced society. She argues that we are losing our sense of community, that being together in online environments, such as Facebook, for example, can create more aloneness.

> Connectivity technologies once promised to give us more boundaries between work and leisure. But as the cell phone and smartphone eroded the boundaries between work and leisure, all the time in the world was not enough. Even when we are not "at work," we experience ourselves "on call"; pressed, we want to edit out complexity and "cut to the chase." (Turkle, 2011, p. 12)

These comments have raised some online readers to push-back, to use a common expression. In an online discussion, Włodzimierz Sobkowiak, a professor of English philology at the Adam Mickiewicz University in Poland asks:

> Why should communities of necessity be "constituted by physical proximity only" is beyond me, frankly, so I'll not even try to analyze this claim [by Turkle] . . . I can assure the reader that the shared concerns, real consequences, and common responsibilities' present in those environments are felt as not a bit less real than in the so-called Real Life. (Retrieved on August 15, 2011, from http://grou.ps/zajek/blogs/item/sherry-turkle-alone-together)

Although technologies have become many things for many people, they can be designed for the creative sharing of perspectives and viewpoints that lead to building better communities of practice in our schools and in our societies.

Since the attack on the World Trade Center more than a decade ago on September 11, 2001, many of us have come to realize that the world is not what we thought it was. We know so little about each other. We know so little about the world. Our educational lenses have focused too long on educational goals that acted as blinders to the world around us. We thought we did not need to understand each other and our diverse perspectives. That one view of knowledge was enough. Yet, what we know and what we make known is always a reflection of our beliefs and assumptions about the world. We need to build new bridges in a socially constructed, interconnected world where people have access to each other's customs, languages, and world views. And, we must rely on our technologies to build connections with people we do not know so that the gulf between us lessens.

Perspectival knowledge, knowledge gleaned from being able to see others' perspectives, enables students, educators, and the public at large to take a second and third look at the many lenses that make up the human experience, even if from a distance. The purpose is not to always approve of what we see, but to learn how to put different worldviews into a new configuration and uncover paths we might not yet see. And we might, if we are brave enough, respect students not only for what has been taught them after they have taken prescribed courses and completed assignments, but also respect them the moment they walk through the door—or through the online portal—as they engage in the formal or informal *learning habitat.*

REFERENCES

Abrahamson, D., Trninic, D., Gutiérrez, J. F., Huth, J., & Lee, R. G. (2011). Hooks and shifts: A dialectical study of mediated discovery. *Technology, Knowledge, and Learning, 16*(1), 55–85.

Ackermann, E. (1996). Perspective-taking and object construction: Two keys to learning. In Y. Kafai & M. Resnick (Eds.), Constructionism in practice (pp. 25–35).

Ahn, J. (2007). *Application of experiential learning cycle in learning from a business simulation game.* Unpublished Doctoral Dissertation. Teachers College, Columbia University, New York, NY.

Alpert, D., & Bitzer, D. L. (1970). Advances in computer-based education. *Science, 167*, 1582–1590.

Ambron, S., & Hooper, K. (1990). *Learning with interactive multimedia*. Redmond, WA: Microsoft Press.

Anderson, J. R. (1993). *Rules of the mind*. Hillsdale, NJ: Erlbaum.

Anderson, J. R., Corbett, A. T., Koedinger, K., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *Journal of Learning Sciences, 4*, 167–207.

Antle, A. N., Corness, G., & Droumeva, M. (2009). What the body knows: Exploring the benefits of embodied metaphors in hybrid physical digital environments. In D. Ramduny-Ellis, A. J. Dix, S. Gill, & J. Hare, (Eds.), *Physicality and interaction* [Special issue]. *Interacting with Computers 21*(1&2), 66–75.

Apple Computer Inc. (1989). *Visual almanac: An interactive multimedia kit. Interactive demonstration kit involving videodisc and hypercard*. Cupertino, CA: Apple Computer Inc.

Ashby, R., & Lee, P. (1987). Children's concepts of empathy and understanding in history. In C. Portal (Ed.), *The History Curriculum for Teachers* (pp. 62–99). London, UK: Falmer Press.

Augusta, Lady Ada, Countess of Lovelace (Translator & Commentator) (1842). L. F. Menabrea, Sketch of the Analytical Engine Invented by Charles Babbage, Bibliothèque Universelle de Genève, October, 1842, No. 82. www.fourmilab.ch/babbage/sketch.html

Bagley, E. A. S., & Shaffer, D. W. (2009). When people get in the way: Promoting civic thinking through epistemic gameplay. *International Journal of Gaming and Computer-Mediated Simulations, 1*(1), 36–52.

Bamberger, J., & diSessa, A. A. (2003). Music as embodied mathematics: A study of a mutually informing affinity. *International Journal of Computers for Mathematical Learning, 8*(2), 123–160.

Barab, S. A., Sadler, T. D., Heiselt, C., Hickey, D., & Zuiker, S. (2007). Relating narrative, inquiry, and inscriptions: Supporting consequential play. *Journal of Science Education and Technology, 16,* 59–82.

Barab, S. A., Thomas, M. K., Dodge, T., Carteaux, R., & Tuzun, H., (2005). Making learning fun: Quest Atlantis, a game without guns. *Educational Technology Research & Development, 53*(1), 86–107.

Barab, S. A., Zuiker, S., Warren, S., Hickey, D., Ingram-Goble, A., Kwon, E-J. Herring, S. C. (2007). Situationally embodied curriculum: Relating formalisms and contexts. *Science Education*, *91*(5), 750–782.

Bakhtin, M. M. (1981). *The dialogic imagination: Four essays*. Holquist, M. (Ed.). (C. Emerson & M. Holquist, Trans.). Austin, TX: University of Texas Press.

Barron B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49,* 193–224.

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology, 59,* 617–645.

Barsalou, L. W. (2010). Grounded cognition: Past, present, and future. *Topics in Cognitive Science, 2*(4), 716–724.

Bartolini Bussi, M. G., & Mariotti, M. A. (2008). Semiotic mediation in the mathematics classroom: Artefacts and signs after a Vygotskian perspective. In L. D. English, M. G. Bartolini Bussi, G. A. Jones, R. Lesh, & D. Tirosh (Eds.), *Handbook of international research in* *mathematics education* (2nd rev. ed., pp. 720–749). Mahwah, NJ: LEA.

Bates, A. W. (1988). Technology for distance education: A 10-year prospective. *Open Learning, 3*(3).

Bates, A. W. (1995). *Technology: Open learning and distance education*. London, UK: Routledge.

Beers, M. (2001). *Subjects-in interaction version 3.0: An intellectual system for modern language student teachers to appropriate multiliteracies as designers and interpreters of digital media texts.* Unpublished doctoral dissertation, University of British Columbia, Vancouver, BC.

Beers, M., & Goldman-Segall, R. (2001). *New roles for student teachers becoming experts: Creating, viewing, and critiquing digital video texts*. Paper presented at the American Educational Research Association Annual Meeting, Seattle, WA.

Belman, J., & Flanagan, M. (2010). Designing games to foster empathy. *Cognitive Technology, 14*(2), 5–15.

Black, J. B. (2007). Imaginary worlds. In M. A. Gluck, J. R. Anderson, & S. M. Kosslyn (Eds.), *Memory and mind*. Mahwah, NJ: LEA.

Black, J. B. (2010). An embodied/grounded cognition perspective on educational technology. In M. S. Khine & I. Saleh (Ed.), *New science of learning: Cognition, computers and collaboration in education*. New York, NY: Springer.

Black, J. B. (2011). Video games as perceptually grounding experiences to enhance formal learning. In F. C. Blumberg (Ed.), *Learning by Playing: Frontiers of Video Gaming in Education*. New York, NY: Oxford University Press.

Black, J. B., Segal, A., Vitale, J., & Fadjo, C. (2012). Embodied cognition and learning environment design. In D. Jonassen & S. Lamb (Eds.), *Theoretical foundations of student-centered learning environments*. New York, NY: Routledge.

Bogost, I. (2007). *Persuasive games: The expressive power of video games*. Cambridge, MA: MIT Press.

Bootstrap Institute. (1994). *Biographical sketch: Douglas C. Engelbart.* www.bootstrap.org/dce-bio.htm

Brand, S. (1987). *The Media Lab: Inventing the future at MIT*. New York, NY: Viking.

Bransford, J. D. & Schwartz, D. L. (2001). Rethinking transfer: A simple proposal with multiple implications. In A. Iran-Nejad & P. D. Pearson (Eds.), *Review of Research in Education 24,* 61–100: American Educational Research Association.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). How people learn: Brain, mind, experience, and school. Washington, DC: National Academy Press.

Bromley, H. (1998). Introduction: Data-driven democracy? Social assessment of educational computing. In H. Bromley & M. W. Apple (Eds.), *Education, technology, power: Educational computing as a social practice* (pp. 1–27). Albany, NY: State University of New York.

Brown, J. S., & Burton, R. R. (1978). A paradigmatic example of an artificially intelligent instructional system. *International Journal of Man-Machine Studies, 10*(3), 323–339.

Brown, J. S., Collins, A., & Duguid, P. (1996 [1989]). Situated cognition and the culture of learning. In H. McLellan (Ed.), *Situated learning perspectives*. Englewood Cliffs, NJ: Educational Technology.

Bruckman, A. (1998). Community support for constructionist learning. *CSCW, 7,* 47–86. www.cc.gatech.edu/elc/papers/bruckman/cscw-bruckman.pdf

Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Bruner, J. S., Oliver, R. R., & Greenfield, P. M. (1966). *Studies in cognitive growth: A collaboration at the center for cognitive studies*. New York, NY: Wiley.

Bryson, M., & Castell, S.d. (1998). Telling tales out of school: Modernist, critical, and "true stories" about educational computing. In H. Bromley & M. W. Apple (Eds.), *Education, Technology, Power: Educational Computing as a Social Practice* (pp. 65–84). Albany: State University of New York.

Burbules, N. C. (2009). Meanings of ubiquitous learning. In B. Cope & M. Kalantzis (Eds.), *Ubiquitous learning* (pp. 15–20). Urbana, IL: University of Illinois Press.

Burbules, N. C., & Abowitz, K. K. (2009). A situated philosophy of education. In R. Glass (Ed.), *Philosophy of Education Society Yearbook 2008* (pp. 268–276). Urbana, IL: Philosophy of Education Society.

Chan, M. S., & Black, J. B. (2006). *Direct-manipulation animation: Incorporating the haptic channel in the learning process to support middle school students in science learning and mental model acquisition*. Proceedings of the International Conference of the Learning Sciences. Mahwah, NJ: LEA.

Cognition and Technology Group at Vanderbilt. (1997). *The Jasper project: Lessons in curriculum, instruction, assessment and professional development*. Mahwah, NJ: LEA.

Cole, M., & Engeström, Y. (1993). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations*. Cambridge, UK: Cambridge University Press.

Cole, M., & Wertsch, J. V. (1996). Beyond the individual-social antinomy in discussions of Piaget and Vygotsky. *Human Development, 39*(5), 250–256.

Cress, U., Fischer, U., Moeller, K., Sauter, C., & Nuerk, H.-C. (2010). The use of a digital dance mat for training kindergarten children in a magnitude comparison task. In K. Gomez, L. Lyons, & J. Radinsky (Eds.), *Learning in the disciplines: Proceedings of the 9th international conference of the learning sciences (ICLS 2010)* (Vol. 1 [Full Papers], pp. 105–112). Chicago, IL: International Society of the Learning Sciences.

Crowder, E. M. (1996). Gestures at work in sense-making science talk. *The Journal of the Learning Sciences, 5*(3), 173–208.

Daniels, V. (2000). *Lecture on John B. Watson.* www.sonoma.edu/people/daniels/Watson.html

Crowder, E. M. & Warburton, E. (1995). *Perspective-taking in classroom science talk*. Paper presented at the Annual Meeting of the American Educational Research Association. San Francisco, CA.

Davy, J. (1985). Mindstorms in the lamplight. In D. Sloan (Ed.), *The computer in education: A critical perspective*. New York, NY: Teachers College Press.

de Castell, S., M. Bryson, & J. Jenson. (2000). *Object lessons: Critical visions of educational technology*. Paper presented at American Educational Research Association Annual Meeting.

Dede, C. (1994). The evolution of constructivist learning environments: Immersion in distributed, virtual worlds. *Educational Technology, 35*(5), 46–52.

Derry, S. & Zalles, D. (2011). *Design research exploring transformative frameworks for learning and education*. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Dewey, J. (1961 [1916]). *Democracy and education: An introduction to the philosophy of education*. New York, NY: Macmillan.

Diamond, J. P. (2012). *"You weren't doing what you would actually do, you were doing what people wanted you to do": A study of historical empathy in a digital history game.* Unpublished doctoral dissertation, New York University, New York, NY.

diSessa, A. A. (1988). Knowledge in pieces. In G. Forman & P. B. Pufall (Eds.), *Constructivism in the Computer Age*. Hillsdale, NJ: LEA.

diSessa, A. A. (2000). *Changing minds: Computers, learning, and literacy*. Cambridge, MA: MIT Press.

diSessa, A. A. (2006). A history of conceptual change research: Threads and fault lines. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences*. Cambridge, UK: Cambridge University Press.

Dam, G. (2011). *A movement game for learning about decision theory*. Paper presented at the Annual Meeting of the Jean Piaget Society, June 2–4. Berkeley, CA.

Domagk, S., Schwartz, R., & Plass, J. L. (2010). Defining interactivity in multimedia learning. *Computers in Human Behavior, 26,* 1024–1033. doi:10.1016/j.chb.2010.03.003

Dourish, P. (2001). *Where the action is: The foundations of embodied interaction*. Cambridge, MA: MIT Press.

Duffy, T. M., & Jonassen, D. (1992). *Constructivism and the technology of instruction: A conversation*. Hillsdale, NJ: LEA.

Edelson, D., Pea, R., & Gomez, L. (1996). Constructivism in the collaboratory. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, NJ: Educational Technology.

Egenfeldt-Nielsen, S. (2005). *Beyond edutainment: Exploring the educational potential of computer games.* Unpublished Doctoral Dissertation, IT-University of Copenhagen.

Erikson, E. H. (1950). *Children and society*. New York, NY: Norton.

Fadjo, C. L., & Black, J. B. (2011). Moving toward the right statement: Effects of grounded embodied cognition on computational thinking. In L. Carlson, C. Holscher, & T. Shipley (Eds.), *Proceedings of the 33rd Annual Conference of the Cognitive Science Society* (p. 1996). Austin, TX.

Fajo, C. L. & Black, J. B. (2011) Moving toward the right statement: Effects of grounded embodied cognition on computational thinking. In L. Carlson, C. Hoelsher, & T. Shipley (Eds.), *Proceedings of the 33rd Annual Conference of the Cognitive Science Society*. Austin, TX.

Falbel, A. (1989). Friskolen 70: An ethnographically informed inquiry into the social context of learning. Unpublished doctoral dissertation, Massachusetts Institute of Technology, Cambridge, MA.

Feenberg, A. (1987). Computer conferencing and the humanities. *Instructional Science, 16*(2), 169–186.

Feldman, A., Konold, C., & Coulter, B. (2000). *Network science, a decade later: The Internet and classroom learning*. Mahwah, NJ: LEA.

Foucault, M. (1980). *Power/knowledge: Selected interviews and other writings,* 1972-1977. C. Gordon (Ed.). New York, NY: Pantheon.

Fox Keller, E. (1983). *A feeling for the organism: The Life and Work of Barbara McClintock*. San Francisco, CA: W. H. Freeman.

Freud, S. (1952). *A general introduction to psychoanalysis*. New York: Washington Square Press.

Flusser, V. (2004). *Writings: Electronic mediations*. Minneapolis, MN: University of Minnesota.

Gardner, H. (1985). *The mind's new science: A history of the cognitive revolution*. New York, NY: Basic Books.

Gee, J. P. (2007). *What videogames have to teach us about learning and literacy* (2nd ed.). New York, NY: Palgrave MacMillan.

Gerofsky, S. (2011). Bringing the graph in closer to the body: Integrating gestural/kinesthetic and sonic cognitive resources in the teaching of polynomial functions in secondary mathematics. Proceedings paper presented at the Annual Meeting of the American Educational Research Association (SIG Advanced Technologies for Learning). New Orleans, LA.

Geertz, C. (1973). *The interpretation of cultures*. New York, NY: Basic Books.

Gibbs, R. (2006). *Embodiment and cognitive science*. Cambridge, MA: Cambridge University Press.

Gilligan, C. (1982). *In a different voice: Psychological theory and women's development*. Cambridge, MA: Harvard University Press, 1982.

Gilster, P. (2000). *Digital literacy: The Jossey-Bass reader on technology and learning*. San Francisco, CA: Jossey-Bass.

Glenberg, A. M. (1997). What memory is for. *The Behavioral and Brain Sciences, 20,* 1–55.

Glenberg, A. M., Goldberg, A., & Zhu, X. (2009). Improving early reading comprehension using embodied CAI. *Instructional Science, 39,* 27–39.

Glenberg, A. M., Gutierrez, T, Levin, J. R., Japuntich, S., & Kaschak, M. P. (2004). Activity and imagined activity can enhance young children's reading comprehension. *Journal of Educational Psychology, 96,* 424–436.

Goffman, E. (1986). *Frame analysis: An essay on the organization of experience*. Boston, MA: Northeastern Univesity Press.

Goldin, G. A. (1987). Levels of language in mathematical problem solving. In C. Janvier (Ed.), *Problems of representation in the teaching and learning of mathematics* (pp. 59–65). Hillsdale, NJ: LEA.

Goldman, R. (2007). Video representations and the perspectivity framework: epistemology, ethnography, evaluation, and ethics. In R. Goldman, R. D. Pea, B. Barron, & S. Derry, (Eds.), *Video research in the learning sciences*. Mahwah, NJ: LEA.

Goldman, R., Crosby, M., Swan, K. & Shea, P. (2005). Introducing Quisitive Research: Expanding qualitative methods for describing learning in ALN. In R., Starr Hiltz & R., Goldman (Eds)., *Learning together online: Research on asynchronous learning networks*. Mahwah, NJ: LEA.

Goldman, R., & Dong, C. (2009). Linking the POV-ing theory to multimedia representations of teaching, learning, and research in the age of social networking. In L. Moller (Ed.), *Visions of the future: Learning and instructional technologies for the 21st century*. New York: Springer.

Goldman, R. & Hiltz, S. R. (2005). Asynchronous learning networks: Looking back and looking forward. In S. R. Hiltz & R. Goldman (Eds.), *Learning together online: Research on asynchronous learning networks*. Mahwah, NJ: Erlbaum.

Goldman, R., Kwah, H., & Abrahamson D., & Hall, R. P.. (2011). *Diverse perspectives on embodied learning: What's so hard to grasp?* Symposium presented at the annual meeting of the American Educational Research Association (SIG Advanced Technologies for Learning). New Orleans, LA.

Goldman, R., Milne, C., Tsai, T., & Kwah, H. (2012) *Connected identities: Middle school girls become designers & researchers in a mathematics game culture*. Presented at the Digital Media for Learning 2012 Conference: Beyond Game Play: Developing Youth Identity as Civic Minded Game Designers Symposium, San Francisco, CA.

Goldman, R., Pea, R. D., Barron, B., & Derry, S. (Eds.) (2007). *Video research in the learning sciences*. Mahwah, NJ: LEA.

Goldman-Segall, (1988). *The growth of a culture* [Film]. MIT Media Lab.

Goldman-Segall, R. (1989). Thick description: A tool for designing ethnographic interactive videodisks. *SIGCHI Bulletin, 21*(2), 118–122.

Goldman-Segall, R. (1990). *Learning Constellations: A multimedia ethnographic research environment using video technology to explore children's thinking.* Unpublished doctoral dissertation, Massachusetts Institute of Technology, Cambridge, MA.

Goldman-Segall, R. (1991). Three children, three styles: A call for opening the curriculum. In I. Harel & S. Papert (Eds.), *Constructionism*. Cambridge, MA: MIT Press.

Goldman-Segall, R. (1993). Interpreting video data: Introducing a "significance measure" to layer descriptions. *Journal for Educational Multimedia and Hypermedia, 2*(3), 261–282.

Goldman-Segall, R. (1994). *Virtual Clayoquot: The Bayside middle school implements a multimedia study of a Canadian rain forest*. Proceedings of Ed-Media '94, Association for the Advancement of Computing in Education, 603–609.

Goldman-Segall, R. (1995). Configurational validity: A proposal for analyzing ethnographic multimedia narratives. *Journal of Educational Multimedia and Hypermedia, 4*(2/3), 163–182.

Goldman-Segall, R. (1996a). Looking through layers: Reflecting upon digital ethnography. *JCT: An Interdisciplinary Journal for Curriculum Studies, 13*(1).

Goldman-Segall, R. (1996b). Challenges facing researchers using multimedia tools. *Computer Graphics Quarterly, 28*(1), 48–52.

Goldman-Segall, R. (1996c). *Genderflexing: A theory of gender and socio-scientific thinking*. Proceedings for the International Conference on the Learning Sciences. Chicago, IL.

Goldman-Segall, R. (1998a). *Points of viewing children's thinking: A digital ethnographer's journey*. Mahwah, NJ: LEA. Interactive video cases at www.pointsofviewing.com/

Goldman-Segall, R. (1998b). Gender and digital media in the context of a middle school science project. *MERIDIAN, a middle school gender and technology electronic journal 1*(1), Debut Edition. www.ncsu.edu/meridian/

Goldman-Segall, R. (1999). *Using video to support professional development & improve practice*. White Paper presented to the Board on International Comparative Studies in Education (BICSE) Invitational Consortium on Uses of Video in International Studies. Washington, DC.

Goldman-Segall, R. (2000). *Video cases: Designing constellations: A perspectivity digital video data analysis tool*. Paper presented at CILT. http://kn.cilt.org/cilt2000/abstracts/2053.html

Goldman-Segall, R., & Maxwell, J. W. (2003). Computers, the Internet, and new media for learning. In I. B. Weiner, W. M. Reynolds, & G. E. Miller (Eds.), *Handbook of psychology: Educational psychology* (Volume 7) (pp. 393–427). Hoboken, NJ: John Wiley & Sons, Inc.

Goldman-Segall, R. & Rao, C. (1998) WebConstellations: A collaborative online digital data tool for creating living narratives in organizational knowledge systems. *Proceedings for the 31st Hawaii International Conference for Systems Sciences, IEEE,* 194–200.

Granott, N. (1991). Puzzled minds and weird creatures: The spontaneous process of knowledge construction. In I. Harel & S. Papert (Eds.), *Constructionism* (pp. 295–310). Norwood, NJ: Ablex.

Graves, W. H. (1999). The instructional management systems cooperative: Converting random acts of progress into global progress. *Educom Review, 34*(6). www.educause.edu/ir/library/html/erm9966.html

Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature, 423,* 534–537.

Green, C. S., & Bavelier, D. (2007). Action-video-game experience alters the spatial resolution of vision. *Psychological Science, 18,* 88–94.

Greenfield, P. M. (1984). A theory of the teracher in the learning activities of everyday life. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context*. Cambridge, MA: Harvard University Press.

Greenfield, P. M., deWinstanley, P., Kilpatrick, H., & Kaye, D. (1994). Action video games and informal education: Effects on strategies for dividing visual attention. *Journal of Applied Developmental Psychology, 15,* 105–123.

Greeno, J. G. (1997). On claims that answer the wrong questions. *Educational Researcher, 26*(1), 5–17.

Gruber, H. E., & Voneche, J. J. (Eds.). (1977). *The Essential Piaget*. New York, NY: Basic Books.

Guzdial, M. (1997). *Information ecology of collaborations in educational settings: Influence of tool*. Paper presented at the Computer-Supported Collaborative Learning. http://guzdial.cc.gatech.edu/papers/infoecol/

Guzdial, M. (1999). *Teacher and student authoring on the web for shifting agency*. Paper presented at the American Educational Research Association Annual Meeting. http://guzdial.cc.gatech.edu/papers/aera99/

Han, I., & Black, J. B. (2011). Incorporating haptic feedback in simulation for learning physics. *Computers and Education, 57,* 2281–2290.

Hammer, J., & Black, J. B. (2009). Games and (preparation for future) learning. Educational Technology, *49,* 29–34.

Harasim, L. M. (Ed.). (1990). Online education: Perspectives on a new environment. Santa Barbara, CA: Praeger.

Harasim, L. M. (Ed.). (1993). *Global networks: Computers and international communication*. Cambridge, MA: MIT Press.

Harasim, L. M. (1993). Networlds: Networks as social space. In L. M. Harasim (Ed.), *Global networks: Computers and international communication*. Cambridge, MA: MIT Press.

Harel, I. (1991). *Children designers: Interdisciplinary constructions for learning and knowing mathematics in a computer-rich school*. Westport, CT: Ablex.

Harel, I., & Papert, S. (Eds.). (1991). *Constructionism*. Norwood, NJ: Ablex.

Harrison, B., & Baecker, R. (1992). *Designing video annotation and analysis systems*. Paper presented at the Proceedings of CHI '92.

Heidegger, M. (1962). *Being and time* (J. Macquarrie & E. Robinson, Trans.). New York, NY: Harper & Row. (Original work published 1927.)

Harvey, B. (1997). *Computer science Logo style* (2nd ed.). Cambridge, MA: MIT Press.

Haynes, C., & Holmevik, J. R. (Eds.). (1998). *High-wired: On the design, use, and theory of educational MOOs*. Ann Arbor, MI: University of Michigan Press.

Hiltz, S. R., & Goldman, R. (Eds). (2005). *Learning together online: Research on asynchronous learning networks*. Mahwah, NJ: LEA.

Hiltz, S. R., & Turoff, M. (1993 [1978]). *The network nation: Human communication via computer* (Rev. ed.). Cambridge, MA: MIT Press.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning, 1*(4).

Hmelo-Silver, C. E., Jordan, R., Liu, L., Gray, S., Demeter, M., Rugaber, S. V., and Goel, A. (2008). Focusing on function: Thinking below the surface of complex natural systems. *Science Scope,* 27–34.

Homer, B. D., & Plass, J. L. (2010). Expertise reversal for iconic representations in science simulations. *Instructional Science, 38,* 259–276.

Hommel, B., Müsseler, J., Aschersleben, G., & Prinz, W. (2001). The theory of event coding (TEC): A framework for perception and action planning. *Behavioral and Brain Sciences, 24,* 849–878.

Howison, M., Trninic, D., Reinholz, D., & Abrahamson, D. (2011). The mathematical imagery trainer: From embodied interaction to conceptual learning. In G. Fitzpatrick, C. Gutwin, B. Begole, W. A. Kellogg, & D. Tan (Eds.), *Proceedings of the annual meeting of CHI: ACM conference on human factors in computing systems (CHI 2011), Vancouver, May 7–12, 2011* (pp. 1989–1998). ACM: CHI (CD-ROM).

Illich, I. (1972). *Deschooling society*. New York, NY: Harrow Books.

Illich, I. (1973). *Tools for conviviality*. New York, NY: Marion Boyars.

Illich, I., & Sanders, B. (1988). *ABC: The alphabetization of the popular mind*. New York, NY: Vintage Books.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking*. Englewood Cliffs, NJ: Merrill.

Jonassen, D. H. (2005). *Modeling with technology: Mindtools for conceptual change* (3rd ed.). New York, NY: Prentice Hall.

Kafai, Y. (1993). *Minds in play: Computer game design as a context for children's learning.* Unpublished Doctoral Dissertation, Graduate School of Education of Harvard, Cambridge, MA.

Kafai, Y. B. (1995). *Minds in play: Computer game design as a context for children's learning*. Mahwah, NJ: Erlbaum.

Kafai, Y. (1996). Software by kids for kids. *Communications of the ACM, 39*(4), 38–39.

Kamenetz, A. (2010). DIYU: *Edupunks, edupreneurs, and the coming transformation of higher education*. White River Junction, VT: Chesea, Green.

Kaput, J., Roschelle, J., & Stroup, W. (1998). SimCalc: Accelerating students' engagement with the mathematics of change. In M. Jacobson & R. Kozma (Eds.), *Educational technology and mathematics and science for the 21st century*. Hillsdale, NJ: Erlbaum.

Keller, E. F. (1985). *Reflections on gender and science*. New Haven, Conn.: Yale University Press.

Krajcik, J., Soloway, E., Blumenfeld, P. C., Marx, R. W., Ladewski, B. L., Bos, N. D., & Hayes, P. J. (1996). The casebook of project practices: An example of an interactive multimedia system for professional development. *Journal of Computers in Mathematics and Science Teaching, 15*(1/2), 119–135.

Katz, S., & Lesgold, A. (1993). The role of the tutor in computer-based collaborative learning situations. In S. P. Lajoie & S. J. Derry (Eds.), *Computers as cognitive tools*. Hilldale, NJ: LEA.

Kay, A. C. (1996). The early history of SmallTalk. In J. Thomas, J. Bergin, J. Richard, & G. Gibson (Eds.), *History of programming languages—II* (pp. 511–578). New York, NY: ACM Press/Addison-Wesley.

Ke, F., & Grabowski, B. (2007). Gameplaying for maths learning: cooperative or not? *British Journal of Educational Technology, 2*(38), 249–259.

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & Education, 55*(2), 427–443.

Kennedy, S. (1989). Using video in the BNR utility lab. *SIGCHI Bulletin, 21*(2), 92–95.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 46*(2), 75–86.

Koschmann, T. (1996). Paradigm shifts and instructional technology: An introduction. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm*. Mahwah, NJ: LEA.

Kuhn, T. (1996). *The Structure of Scientific Revolutions* (3rd Edition ed.). Chicago, IL: University of Chicago Press.

Kulik, J., & Kulik, C. (1991) Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior,* (7), 75–94.

Kwah, H., & Goldman, R., (2011). *Empathetic embodiments and diagrammatic gestures for teaching robot programming*. Proceedings of the American Educational Research Association. New Orleans, LA.

Kwah, H., Milne, C., Goldman, R., & Plass, J. L. (2012). *Emotional engagement, social interactions, and the development of an after-school game design curriculum*. Proceedings of the American Educational Research Association. Vancouver, BC, Canada.

Lajoie, S. P., & Derry, S. J. (1993). *Computers as Cognitive Tools*. Hillsdale, NJ: LEA.

Landow, G. P. (1992). *Hypertext: The convergence of contemporary critical theory and technology*. Baltimore, MD: Johns Hopkins University Press.

Landow, G. P. (1994). What's a critic to do?: Critical theory in the age of hypertext, *Hyper/text/ theory* (pp. 225–267). Baltimore. MD: Johns Hopkins University Press.

Landow, G. P., & Delany, P. (1993). *The digital word: Text-based computing in the humanities*. Cambridge, MA: MIT Press.

Lave, J. (1988). *Cognition in practice: Mind, mathematics, and culture in everyday life*. Cambridge, UK: Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge, UK: Cambridge University Press.

Lee, P., & Ashby, R. (2001). Empathy, perspective taking, and rational understanding. In O. L. Davis, Jr., E. A. Yeager, & S. J. Foster (Eds.), *Historical Empathy and Perspective Taking in the Social Studies* (pp. 21–50). Lanham, MD: Rowman & Littlefield.

Lemke, J. (1998). Multiplying meaning: Visual and verbal semiotics in scientific text. In J. R. Martin & R. Veel (Eds.), *Reading science*. London, UK: Routledge.

Lemke, J. L. (2001). Semantic topography and textual meaning. In J. de Villiers & R. Stainton (Eds.), *Communication in linguistics* (pp. 237–260). Toronto, Canada: Editions du GREF.

Leong, Z. A., & Horn, M. S. (2011). Representing equality: A tangible balance beam for early algebra education. In P. Blikstein & P. Marshall (Eds.), *Proceedings of the 10th annual interaction design and children conference (IDC 2011)* (pp. 173–176). Ann Arbor, MI: IDC.

Levin, J., Riel, M., Miyake, N., & Cohen, E. (1987). Education on the electronic frontier. *Contemporary Educational Psychology, 12,* 254–260.

Lévi-Strauss, C. (1968). *The savage mind*. Chicago, IL: University of Chicage Press.

Lim, C. P., Nonis, D., & Hedberg, J. (2006). Gaming in a 3D multiuser virtual environment: Engaging students in science lessons. *British Journal of Educational Technology 2,* 37, 211–231.

Mackay, W. (1989). EVA: An experimental video annotator for symbolic analysis of video data. *SIGCHI Bulletin, 21*(2), 68–71.

Martin, F. (1995). The art of Lego design. *The Robotics Practitioner: The Journal for Robot Builders,* (1)*2*.

Martin, F., & Resnick, M. (1993). Lego/Logo and electronic bricks: Creating a scienceland for children. In D. L. Ferguson (Ed.), *Advanced educational technologies for mathematics and science*. Berlin Heidelberg, Germany: Springer-Verlag.

Martin, L. M. W. (1987). Teachers' adoption of multimedia technologies for science and mathematics instruction. In R. D. Pea & K. Sheingold (Eds.), *Mirrors of minds: Patterns of experience in educational computing*. Norwood, NJ: Ablex.

Mayer, R. E., MacNamara, A., & Adams, D. M. (2011). *Is there an advantage to learning from narrative computer games?* Paper presented at the 2011 AERA Annual Meeting. New Orleans, LA.

Merleau-Ponty, M. (1958/2005). *Phenomenology of perception* (C. Smith, Trans.). New York, NY: Routledge. (Original work published 1945)

McLuhan, M. (1964). *Understanding media: The extensions of man*. New York, NY: McGraw Hill.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago, IL: University of Chicago Press.

Minsky, M. (1986). *The society of mind*. New York, NY: Simon & Schuster.

Nardi, B., & O'Day, V. (1999). *Information ecology: Using technology with heart*. Cambridge, MA: MIT Press.

Nemirovsky, R., Tierney, C., & Wright, T. (1998). Body motion and graphing. *Cognition and Instruction, 16*(2), 119–172.

Núñez, R. E., Edwards, L. D., & Matos, J. F. (1999). Embodied cognition as grounding for situatedness and context in mathematics education. *Educational Studies in Mathematics, 39,* 45–65.

Noble, D. (1985). *Computer literacy and ideology.* In D. Sloan (Ed.), *The computer in education: A critical perspective*. New York, NY: Teachers College Press.

Noble, D. (1999). *Digital diploma mills part IV: Rehearsal for the revolution.* http://communication.ucsd.edu/dl/ddm4.html

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & Education, 52*(1), 1–12.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York, NY: Basic Books.

Papert, S. (1987 [1985]). Information technology and education: Computer criticism vs technocentric thinking. *Educational Researcher, 16*(1), 22–30.

Papert, S. (1988). The conservation of Piaget: The computer as grist to the constructionist mill. *Constructivism in the Computer Age*. Hillsdale, NJ: LEA.

Papert, S. (1991). Situating constructionism. In I. Harel & S. Papert (Eds.), *Constructionism*. Norwood, NJ: Ablex.

Papert, S. (1992). *The children's machine.* New York: Basic Books.

Pea, R., & Kurland, D. M. (1987 [1984]). On the cognitive effects of learning computer programming. In R. Pea & K. Sheingold (Eds.), *Mirrors of minds*. Norwood, NJ: Ablex.

Pea, R., Kurland, D. M., & Hawkins, J. (1987). Logo and the development of thinking skills. In R. Pea & K. Sheingold (Eds.), *Mirrors of minds*. Norwood, NJ: Ablex.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations*. Cambridge, MA: Cambridge University Press.

Pea, R. D. (1987). Cognitive technologies for mathematics education. In A. Schoenfeld (Ed.), *Cognitive science and mathematics education* (pp. 89–122). Hillsdale, NJ: Erlbaum.

Pearson Education. (2000). *Pearson education history.* www.pearsoned .com/history.htm

Perkins, D. N. (1991). Technology and constructivism: Do they make a marriage? *Educational Technology, 31*(5), 18–23.

Petrick, C., & Martin, T. (2011). *Hands up, know body move: Learning mathematics through embodied actions*. Manuscript in progress (copy on file with author).

Petrosino, A. J. (2003). Commentary: A framework for supporting learning and teaching about mathematical and scientific models. *Contemporary Issues in Technology and Teacher Education, 3*(3), 288–299.

Petrosino, A. J. (2004). Integrating curriculum, instruction, and assessment in project-based instruction: A case study of an experienced teacher. Journal of Science Education and Technology, *13*(2), 127–134.

Piaget, J. (1930). *The child's conception of the world*. London, UK; New York, NY: Harcourt, Brace, and World.

Piaget, J. (1952). *The child's conception of number*. London, UK: Routledge & Kegan Paul.

Piaget, J. (1969). *The child's conception of time*. London, UK: Rutledge & Kegan Paul.

Piaget, J., & Inhelder, B. (1956). *The child's conception of space*. London, UK: Routledge & Kegan Paul.

Piaget, J., & Inhelder, B. (1969). *The psychology of the child* (H. Weaver, Trans.). New York, NY: Basic Books. (Original work published 1966)

Picard, R. (1997). *Affective computing*. Cambridge, MA: MIT Press.

Picard, R. W. (2010). Emotion research by the people, for the people. *Emotion Review,* (2)*3*.

Plass, J. L., Goldman, R., Flanagan, M., & Perlin, K. (2009). RAPUNSEL: Improving self-efficacy and self-esteem with an educational computer game. In S. C. Kong, H. Ogata, H. C. Arnseth, C. K. K. Chan, T. Hirashima, F. Klett, J. H. M. Lee, C. C. Liu, C. K. Looi, M. Milrad, A. Mitrovic, K. Nakabayashi, S. L. Wong, & S. J. H. Yang (Eds.) *Proceedings of the 17th international conference on computers in education* [CD-ROM]. Hong Kong, China: Asia-Pacific Society for Computers in Education.

Plass, J. L., Homer, B. D., & Hayward, E. (2009). Design factors for educationally effective animations and simulations. *Journal of Computing in Higher Education, 21*(1), 31–61.

Plass, J. L., Homer, B. D., Hayward, E., Frye, J., Huang, T.-T., Biles, M., . . . Perlin, K. (2011). *An experimental investigation of the effect of learning mechanics design on learning outcomes in a computer-based geometry game*. Submitted for publication.

Plass, J. L., Homer, B. D., Milne, C., Jordan, T., Kalyuga, S., Kim, M., & Lee, H. J. (2009). Design factors for effective science simulations: Representation of information. *International Journal of Gaming and Computer-Mediated Simulations, 1*(1), 16–35.

Plass, J. L., Perlin, K., & Isbister, K. (2010). *The games for learning institute: research on design patterns for effective educational games*. Paper presented at the Game Developers Conference, San Francisco, CA, March 9–13, 2010.

Prensky, M. (2007). *Digital game-based learning*. New York, NY: Paragon House.

Radford, L. (2003). Gestures, speech, and the sprouting of signs: A semiotic-cultural approach to students' types of generalization. *Mathematical Thinking and Learning, 5*(1), 37–70.

Rasanen, P., Salminen, J., Wilson, A. J., Aunio, P., & Dehaene, S. (2009). Computer-assisted intervention for children with low numeracy skills. *Cognitive Development, 24*(4), 450–472.

Resnick, M. (1991). Overcoming the centralized mindset: Towards an understanding of emergent phenomena. In I. Harel & S. Papert (Eds.), *Constructionism*. Norwood, NJ: Ablex.

Resnick, M. (1994). *Turtles, termites, traffic jams: Explorations in massively parallel microworlds*. Cambridge, MA: MIT Press.

Resnick, M., & Ocko, S. (1991). Lego/logo: Learning through and about design. In I. Harel & S. Papert (Eds.), *Constructionism*. Norwood: NJ: Ablex.

Resnick, M. (1996). Beyond the Centralized Mindset. *Journal of the Learning Sciences, 5*(1), 1–22.

Resnick, M., & Wilensky, U. (1998). Diving into complexity: Developing probabilistic decentralized thinking through role-playing activities. *Journal of Learning Sciences, 7*(2). http://ccl.sesp .northwestern.edu/cm/papers/starpeople/

Riel, M. (1993). Global education through learning circles. In L. M. Harasim (Ed.), *Global networks: Computers and international communication*. Cambridge, MA: MIT Press.

Riel, M. (1996). Cross-classroom collaboration: Communication and education. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm*. Mahwah, NJ: LEA.

Romiszowski, A. J., & de Haas, J. A. (1989). Computer-mediated communication for instruction: Using e-mail as a seminar. *Educational Technology, 20*(10), 7–14.

Roschelle, J., Kaput, J., Stroup, W., & Kahn, T. M. (1998). Scaleable integration of educational software: Exploring the promise of component architectures. *Journal of Interactive Media in Education, 98*(6). www.jime.open.ac.uk/98/6

Roschelle, J., Pea, R., & Trigg, R. (1990). Video Noter: A tool for exploratory video analysis (IRL Technical Report IRL 90–0021): IRL.

Rowland, J. (2004). Shall we dance? A design epistemology for organized learning and performance. *Educational Technology, Research, and Development, 52*(1), 33–48.

Sachter, J. E. (1990). *Kids in space: Exploration into spatial cognition of children's learning 3-D computer graphics*. Unpublished doctoral dissertation, Massachusetts Institute of Technology, Cambridge, MA.

Salomon, G. (1979). *Interaction of media, cognition, and learning*. San Francisco, CA: Jossey-Bass.

Salomon, G. (1993). No distribution without individuals' cognition: A dynamic interactional view. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations*. Cambridge, UK: Cambridge University Press.

Salomon, G., & Gardner, H. (1986). The computer as educator: Lessons from television research. *Educational Researcher, 15*(1), 13–19.

Salomon, G., Perkins, D. N., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher, 20*(3), 2–9.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences, 1*(1), 37–68.

Schank, R. C. (2000, July). *Educational outrage: Are computers the bad guys in education?* http://movietone.ils.nwu.edu/ edoutrage/edoutrage11.html

Schlager, M. S., & Schank, P. K. (1997. TAPPED IN: A new on-line community concept for the next generation of Internet technology. In R. Hall, N. Miyake & N. Enyedy (Eds.), *Proceedings of the Second*

International Conference on Computer Support for Collaborative Learning (pp. 231–240). Hillsdale, NJ: Erlbaum.

Scribner, S., & Cole, M. (1981). *The psychology of literacy*. Cambridge, MA: Harvard University Press.

Shaffer, D. W. (2006). *How computer games help children learn*. New York, NY: Palgrave Macmillan.

Simon, H. A. (1981 [1969]). *The sciences of the artificial*. Cambridge, MA: MIT Press.

Sloan, D. (Ed.). (1985). *The computer in education: A critical perspective*. New York, NY: Teachers College Press.

Skemp, R. R. (1983). The silent music of mathematics. *Mathematics Teaching, 102*(58), 287–288.

Spiro, R. J., Collins, B. P., & Aparna Ramchandran, A. (2007). Reflections on a Post-Gutenberg epistemology for video use in ill-structured domains: Fostering complex learning and cognitive flexibility. In Goldman, R., Pea, R. D., Barron, B., & Derry, S. (Eds.) *Video Research in the Learning Sciences*. Mahwah, NJ: LEA.

Sobkowiak, W. Blog entry. Retrieved on August 15, 2011, grou.ps/zajek/blogs/item/sherry-turkle-alone-together

Squire, K. (2004). *Replaying history: Learning world history through playing civilization III.* Unpublished Doctoral Dissertation, Indiana University, Bloomington.

Squire, K., Barnett, M., Grant, J. M., & Higginbotham, T. (2004). *Electromagnetism supercharged!: Learning physics with digital simulation games*. Proceedings of the 6th International Conference on Learning Sciences, Santa Monica, CA.

Stahl, G. (1999). *WebGuide: Guiding collaborative learning on the web with perspectives*. Paper presented at the American Educational Research Association. www.cs.colorado.edu/~gerry/publications/conferences/1999/aera99/

Steinkuehler, C. & Duncan, S. (2009). Informal scientific reasoning in online virtual worlds. *Journal of Science Education & Technology, 6*(17), 530–543.

Stone, A. R. (1995). *The war between desire and technology at the end of the mechanical age*. Cambridge. MA: MIT Press.

Subrahmanyam, K., & Greenfield, P. (1994). Effects of video game practice on spatial skills in girls and boys. *Journal of Applied Developmental Psychology, 15,* 13–32.

Suchman, L. A. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge, UK: Cambridge University Press.

Suppes, P. (1966). The uses of computers in education. *Scientific American, 215*(3), 206–220.

Suppes, P., Jerman, M., & Brian, D. (1968). *Computer-assisted instruction: Stanford's 1965–66 arithmetic program*. New York, NY: Academic Press.

Suppes, P., & Morningstar, M. (1972). *Computer-assisted instruction at Stanford, 1966–68: Data, models, and evaluation of the arithmetic programs*. New York, NY: Academic Press.

Swan, K. (1994). History, hypermedia, and criss-crossed conceptual landscapes. *Journal of Educational Multimedia and Hypermedia, 3*(2), 120–139.

Tapscott, D. (2000). The digital divide, *The Jossey-Bass reader on technology and learning*. San Francisco, CA: Jossey-Bass.

Thorndike, E. L. (1899). Animal intelligence. *Psychological Review, 7,* 105–124.

Thorndike, E. L. (1903) *Educational Psychology*. New York, NY: Teachers College, Columbia University.

Tinker , R. (Ed). (1996) *Microcomputer based labs: Educational research and standards*. Springer-Verlag: Berlin.

Toulmin, S. E. (1972) *Human understanding* (Vol. 1). Princeton, NJ: Princeton University Press.

Trinh, M.-H. (1992). *Framer-framed*. New York, NY: Routledge.

Trninic, D., Reinholz, D., Howison, M., & Abrahamson, D. (2010). Design as an object-to-think-with: Semiotic potential emerges through collaborative reflective conversation with material. In P. Brosnan, D. Erchick, & L. Flevares (Eds.), *Proceedings of the thirty-second annual meeting of the North-American chapter of the international group for the psychology of mathematics education (PME-NA 32)* (Vol. VI, ch. 18: Technology, pp. 1523–1530). Columbus, OH: PME-NA.

Turkle, S. (1984). *The second self: Computers and the human spirit*. New York, NY: Simon & Schuster.

Turkle, S. (1988). Computational reticence: Why women fear the intimate machine. In C. Kramarae (Ed.), *Technology and Women's Voices*. New York, NY: Routledge and Kegan Paul.

Turkle, S. (1995). *Life on the screen: Identity in the age of the Internet*. New York, NY: Simon & Schuster.

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other*. New York, NY: Basic Books.

Turkle, S., & Papert, S. (1991). Epistemological pluralism: Styles and voices within the computer culture. In I. Harel & S. Papert (Eds.), *Constructionism*. Cambridge, MA: MIT Press.

Vanderbilt Learning Technology Center website. http://peabody.vanderbilt.edu/ctrs/ltc/Research/jasper.html

Vygotsky, L. S. (1962). *Thought and language* (E. Hanfmann & G. Vakar, Trans.). Cambridge, MA: MIT Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wegerif, R. (2007). *Dialogic education and technology: Expanding the space of learning*. New York, NY: Springer.

Wenger, E. (1987). *Artificial intelligence and tutoring systems: Computational and cognitive approaches to the communication of knowledge*. Los Altos, CA: Kaufmann.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, UK: Cambridge University Press.

Willinsky, J. (2006). *The access principle: The case of open access to research and scholarship*. Cambridge, MA: MIT Press.

Willinsky, J. (1990). *The new literacy: Redefining reading and writing in schools*. New York, NY: Routledge.

Wilensky, U. (1993). *Connected mathematics: Building concrete relationships with mathematical knowledge.* Unpublished Doctoral Dissertation. MIT Media Lab.

Wilensky, U. (1999). *NetLogo* [computer software]. Evanston, IL: Center for Connected Learning and Computer-Based Modeling, Northwestern University. http://ccl.northwestern.edu/netlogo

Wilensky, U. (2001). *Modeling nature's emergent patterns with multi-agent languages*. Proceedings of the Eurologo 2001 Conference.

Wilensky, U., & Reisman, K. (2006). Thinking like a wolf, a sheep or a firefly: Learning biology through constructing and testing computational theories. *Cognition and Instruction, 24*(2), 171–209.

Wilensky, U., & Resnick, M. (1999). Thinking in levels: A dynamic systems approach to making sense of the world. *Journal of Science Education and Technology, 8*(1), 3–19.

Wilensky, U., & Stroup, W. (1999). *Learning through participatory simulations: Network-based design for systems learning in classrooms*. Proceedings of the Computer-Supported Collaborative Learning. http://ccl.northwestern.edu/cm/papers/partsims/cscl/

Winograd, T., & Flores, F. (1986). *Understanding computers and cognition: A new foundation for design*. Norwood, NJ: Ablex.

Wittgenstein, L. (1953). *Philosophical investigations*. (G. E. M. Anscombe, Trans.). Oxford, UK: Basil Blackwell.

Wolfson, L., & Willinsky, J. (1998). Situated learning in high school information technology management. *Journal of Research on Computing in Education, 31*(1).

Woolley, D. R. (1994). PLATO: The emergence of online community. *Computer-Mediated Communication Magazine, 1*(3). www.december.com/cmc/mag/1994/jul/plato.html

Zins, J. E. & Elias, M. J. (2006). Social and emotional learning. In G. G. Bear & K. M. Minke (Eds.), *Children's needs III: Development, prevention, and intervention* (pp. 1–13). Bethesda, MD: National Association of School Psychologists.

CHAPTER 15

School Psychology

MARIBETH GETTINGER, ERIN BRODHAGEN, MICHELYN BUTLER, AND CLARISSA SCHIENEBECK

INTRODUCTION

School psychology is an area of applied psychology with strong connections to the fields of both education and psychology. In general, school psychology concerns itself with the educational, social, and emotional development of children. Although not limited to schools, school psychology services are provided to children, families, and educators primarily within the context of educational settings. Over the years, the training and experiences of school psychologists have expanded to the point where their skills are applicable in a variety of nonschool settings as well. School psychologists provide an understanding of multiple factors that influence children's cognitive and social-emotional functioning, irrespective of the context.

Unlike other areas of professional psychology, such as clinical psychology and counseling psychology, school psychology is focused predominantly on school environments (e.g., classrooms, teachers, peer groups) and on learning and mental health issues related to children's education (Minke & Brown, 1996). In addition, unique to school psychology practice is a dual focus on providing both direct services and support to children, as well indirect services through training and consultation for other professionals or adults who influence children's learning and development (e.g., teachers, parents, care providers). In sum, through the application of psychological principles combined with knowledge of effective teaching-learning processes, the overarching purpose of school psychology is to promote the positive academic, behavioral, and social-emotional development of children and youth.

The purpose of this chapter is to describe the development and current status of the field of school psychology, highlighting both historical and recent legislative, policy, and professional initiatives that have contributed to the current evolution of the field. Whereas the early history of school psychology was inextricably linked to intelligence testing and identification of children with special education needs, several recent reform initiatives have created both challenges and opportunities for school psychology to move beyond a traditional testing role. The education of today's school psychologists prepares them to provide a range of intervention, prevention, health promotion, and program development and evaluation services, in addition to assessment and evaluation. As such, a primary emphasis for contemporary school psychology has shifted from the diagnosis of children who are referred for learning or behavior problems to the prevention of school failure and promotion of academic success for all children.

BRIEF HISTORY OF SCHOOL PSYCHOLOGY

Because school psychology is closely intertwined with both psychology and education, the history and development of the field has been influenced significantly by prominent psychologists as well as major initiatives in U.S. education. In their analysis of the historical context surrounding the development of school psychology, Fagan and Wise (2007) identify two somewhat overlapping periods of development, the "hybrid years," occurring between 1890 and 1970, and the "thoroughbred years," representing the period from 1970 to the present. This distinction is intended to characterize the early period of school psychology as a loosely organized hybrid of professionals in both psychology and education who were focused primarily on the assessment and treatment of children with special learning needs. The term "thoroughbred" reflects the significant growth beginning around 1970 of school psychology as a separate and distinct profession, as evidenced by an increase in the number of training programs, credentialing standards, professional organizations, and scholarly journals devoted to school psychology research. Indeed, school psychology is a field that has been continuously evolving and expanding since the earliest years of the profession. Whereas multiple events since the latter part of the 19th century have shaped the development of school psychology, three historical trends, in particular, converged to provide the foundation on which school psychology was originally based. These include (1) major social-political reforms in American education, (2) the advent of intelligence testing and the inextricable association of school psychology with assessment, and (3) the relationship between school psychology and special education, as regulated by federal policy and legislation.

The origin of school psychology in the late 1800s has been linked to several socio-political events that were occurring near the turn of the century. The period from 1890 to 1920 was an era of significant social and educational reforms, many of which directly or indirectly triggered the development of school psychology. Among the critical events during this period, perhaps most important to school psychology was the enactment of compulsory education laws in all states, with Mississippi being the last state to pass such laws in 1918 (Braden, DiMarino-Linnen, & Good, 2001). As a result of compulsory education, there was an overall increase in public school enrollment, particularly among children from diverse racial-ethnic and socioeconomic backgrounds, many of whom had never attended school previously and exhibited wide variation in their ability and achievement levels. This dramatic shift in the sheer number, range of abilities, and diverse demographics of children attending school created a critical need for professionals to assist in the process of "sorting" children (primarily through testing) into appropriate educational levels (Fagan, 1992). Compulsory education also served as the catalyst for developing special education. Children who had previously been truant, delinquent, or unsuccessful in school were now required to attend school, which necessitated the provision of special educational services. Thus, the identity of school psychology professionals as "sorters" of children and "gatekeepers" for special education was clearly initiated by the advent of compulsory education.

The practice of psychology within educational settings emerged in the United States in the late 19th century, driven, in large part, by the need to provide education for an increasingly diverse population of children. The actual beginning of school psychology as a profession is typically linked with Lightner Witmer, who is considered to be the founder of school psychology. Witmer's recognition of the need to diagnose and treat children who were unable to achieve academically led him to establish a psychological clinic at the University of Pennsylvania in Philadelphia in 1896 (Merrell, Ervin, & Gimpel, 2006). Considered to be the first child guidance clinic in the United States, Witmer's primary focus was on the application of the science of psychology, rather than a traditional introspective focus, to help educators address children's school-related problems (Baker, 1988). Witmer's clinic also reflected the growing emphasis in schools on mental health during the early 1900s and the interest among psychologists in providing services for children and youth with educational and/or social-emotional concerns. Following Witmer's psychological clinic, the first clinic facilities directly linked to a school district were established in 1899 in the Chicago Public Schools by William Healey, as part of the Child Study Movement initiated by G. Stanley Hall. These clinics continued to operate through the 1920s. In contrast to child guidance clinics, psychologists working in Chicago's clinics provided group and individual testing, as well as guidance or therapy services (primarily for juvenile delinquents), directly in the schools (Fagan & Wise, 2007). Although the term "school psychologist" was first used in 1911, the term "clinical psychologist" was typically used to refer to all applied psychologists, including those working in psycho-educational clinics, through the early part of the 20th century. The first person to have held a position with the official title of school psychologist is generally considered to be Arnold Gesell. Gesell was hired by the state of Connecticut in 1915 to test children in schools for special education placement.

Without question, one of the most influential events in the history of school psychology was the emergence of mental abilities testing during the first part of the 20th century and, in particular, the publication of the Binet-Simon scales of intelligence in 1905 (Oakland & Jimerson, 2006). The development of intelligence tests proved to have a powerful and enduring influence on the field of school psychology. Whereas research psychologists, such as Francis Galton and James Cattell, experimented with laboratory tasks to measure intellectual abilities, contemporary intelligence testing in education can be traced directly to the work of Alfred Binet (Pollack & Brenner, 1969). Binet and his colleague, Theodore Simon, were commissioned by the minister of public education in Paris, France, to develop a measure that could be used to identify children who were not successful in general education settings and required special services. The result of their work was the development of the Binet-Simon Scales, a series of individually administered tests that were originally published in 1905. The Binet-Simon scales were later revised and translated into English by Lewis Terman and his associates at Stanford University for use in the United States. The publication of the *Stanford-Binet Intelligence Scales* in 1918, in effect, launched the mental abilities testing moving in this country (Kaufman, 2000).

With the publication of the Stanford-Binet scales, intelligence testing and the identification of children with special needs became widespread in America's schools and simultaneously created a critical need for school psychologists (Talley, Kubiszyn, Brassard, & Short, 1996). The distinctive role of school psychologists in administering IQ tests to identify children with special needs is firmly rooted in a medical model. From a medical perspective, the origins of children's problems are considered to be "within the child" and can only be identified by conducting assessments, including the administration of IQ tests, to diagnose these problems (Fagan, 2002). Because of the prominence of the medical model, psycho-educational testing became commonplace in public schools by the 1920s. Indeed, tests became the major tools of psychologists employed in schools, and the administration and interpretation of tests became their primary role (Kaufman, 2000).

Between 1920 and 1960, the growth of the profession of school psychology gained steady momentum as a result of several factors. First, due to the "baby boom" following World War II, there was a significant increase during the 1950s and 1960s in the number of school-age children, including a concomitant increase in the overall number of children experiencing learning and/or social-emotional or behavioral challenges in school. Analogous to the impact of compulsory education in the early 1900s, this shift in the population of schoolchildren necessitated more specialized school personnel to address their learning problems. Second, the 1960s constituted a progressive decade in U.S. history with an emphasis on prevention, mental health, and quality education for all children, all of which ascribed greater importance to the role of applied psychologists (Nastasi, Varjas, Bernstein, & Pluymert, 1998). Finally, the development of professional organizations and establishment of training programs and state credentialing for school psychologists during this time period contributed significantly to the expansion of the field (Pryzwansky, 1993). The first training program specifically for school psychologists was developed at New York University in the mid-1920s, followed by Pennsylvania State University in the 1930s. Not surprising, New York and Pennsylvania were also the first states to establish criteria and procedures to attain certification for school psychology practice through each state's Department of Education. Between 1940 and 1970, the number of state-certified school psychologists grew from 500 to 5,000, and the number of universities with school psychology training programs increased to more than 100 (Fagan & Wise, 2007). An important milestone for the profession also occurred in 1930 with the publication of the first text with an exclusive focus on school psychology, entitled *Psychological Service for School Problems*, written by Gertrude Hildreth (1930).

Two professional organizations played a critical role in the development of school psychology as a profession during this period of expansion. The first organization founded exclusively for school psychologists was the Division of School Psychology (Division 16) within the American Psychological Association (APA). One of the original 18 divisions created during the reorganization of the APA in 1945, Division 16 was established to represent the interest of psychologists working in school settings. In addition to providing a national organizational identity for the growing number of school psychology professionals, Division 16 initiated procedures and criteria for training program accreditation by the APA in 1963. The APA accredited its first school psychology doctoral program in 1971 at the University of Texas-Austin (Fagan, 1996). In 1969, a group of school psychologists in Ohio, who believed that Division 16 was not adequately representing the unique interests of nondoctoral school psychology practitioners, convened to consider establishing a second professional school psychology organization (Fagan, 1994). This initial meeting led to the St. Louis Convention, during which the National Association of School Psychologists (NASP) was formed to more actively promote the interests of practicing school psychologists. The founding of NASP signaled that the field of school psychology had achieved a strong professional identity (Jackson, 1990).

During the 1940s and 1950s, two national professional psychology conferences were held, which made lasting contributions to the conceptualization of training and practice in school psychology. The first was a joint meeting in 1949 between the National Institutes of Health and the American Psychological Association, which came to be known as the Boulder Conference (Martens & Keller, 1987). Although focusing on training and practice in clinical psychology, the Boulder Conference had a critical impact on school psychology professional development as well. Specifically, the notion that science should guide the practice of psychology and that training should include an equal and balanced emphasis on both research and training grew out of the discussions of the Boulder Conference. Conference participants agreed that research is an important part of clinical practice and that, in turn, involvement in the clinical process can inform research. This conceptualization of a clinical psychologist became known as the *scientist-practitioner* and resulted in the specification of a scientist-practitioner model of training for professional psychology programs (Lambert, 1993).

Five years later, the Thayer Conference was held in 1954 to advance specialty training, credentialing, and practice in school psychology. The Thayer Conference participants embraced many of the concepts emerging from the Boulder Conference and affirmed the important role of science in both school psychology training and practice. Moreover, the Thayer Conference proceedings, as well as proceedings from the subsequent Spring Hill Symposium in 1980 and Olympia Conference in 1981, provided a comprehensive written document describing the field of school psychology and providing a framework to guide training, practice, and credentialing. One of the significant recommendations emanating from the Thayer Conference was the necessity for having two levels of school psychology credentialing and training, one at the doctoral level and another at the master's level. (Note: The dual-level training perspective in school psychology is addressed in the following section, Professional School Psychology.)

Subsequent to the period of gradual growth of school psychology between the 1920s and 1960s came a period of dramatic expansion during the 1970s and 1980s. The rapid growth during this time period is considered by many historians to have been a direct result of the passage of federal laws for the education of students with disabilities, most notably the Education for All Handicapped Children Act in 1975, or Public Law (PL) 94–142 (Fagan, 1992). PL 94–142 mandated a "free and appropriate" education for all children with handicapping conditions and required that students identified as having disabilities be provided with "related" services as needed, including psychological services. Thus, school psychologists became essential special service providers in schools and, importantly, were necessary for determining the existence of handicapping conditions and need for special education. Because PL 94–142 mandated appropriate assessment of children for determining eligibility for special education, a greater number of school psychologists were needed, with particular expertise in ability and achievement testing (Talley et al., 1996). In addition to expanding the field of school psychology, PL 94–142 also solidified the identity of school psychologists as "gatekeepers" for special education and "sorters" of children. In effect, the legal mandate for assessment and placement embodied in 94–142 and subsequent legislation (e.g., Individuals with Disabilities Education Act) came at the expense of limiting school psychologists' opportunities to be involved in prevention, intervention and consultation activities (Reschly, 2000). Beyond role specification, several definitions and mandates articulated in 94–142 and its successors have also contributed to delineating specific skills and training required of school psychologists (Farrell, 2010). For example, defining "learning disability" as a significant discrepancy between ability and achievement meant that school psychologists needed to be trained specifically to administer and interpret intelligence and achievement testing in order to categorize students. As another example, the 1997 reauthorization of the special education law (now termed the Individuals with Disabilities Education Act, or IDEA) required that a functional behavioral assessment (FBA) be completed for all children referred for emotional-behavioral disabilities, thus leading to an increase in the focus on FBA skills in school psychology training programs.

In sum, multiple events and demographic trends have contributed to the growth and development of school psychology as a profession since the late 1800s. Over the past century, school psychology has evolved as a specialty area with core knowledge and skills rooted in both education and psychology. Although school psychology contributes to psychology due to its focus on children and their cognitive and social-emotional development, school psychologists have been and continue to be strongly associated with schools and the schooling process (Minke & Brown, 1996). In that school psychologists remain integral to the functioning of schools and to the well-being of children within school settings, their professional activities will continue to be influenced and regulated by the sociopolitical, economic and legislative forces that have an impact on public education. In the years since the emergence of school psychology, a variety of diverse role and functions have been offered as being appropriate for school psychologists. Despite progress in recent years toward greater role expansion for school psychology, the duties of many school psychologists continue to revolve around the profession's earliest roots in child study, assessment, and measurement (D'Amato, Zafiris, McConnell, & Dean, 2011).

PROFESSIONAL SCHOOL PSYCHOLOGY

A distinguishing feature of what Fagan and Wise (2007) called the "thoroughbred years" in school psychology has been significant growth in the regulation of training, credentialing of practitioners, and identity of school psychology as a profession, beginning in 1970. In addition, the field of school psychology has been affected by the continuing policy differences between the American Psychological Association (APA) and the National Association of School Psychologists (NASP). Although beyond the scope of this chapter to explore in detail the philosophical differences between APA and NASP, it is important to note that both organizations have influenced the professionalization of school psychology. A major (and sometimes contentious) difference between the two organizations is related to the training requirements for entry-level practice in psychology. Discussions of professional school psychology often come down to a fundamental question regarding whether school psychology is a specialization within professional psychology, or whether it constitutes a separate discipline. Whereas APA views school psychology as a specialty within psychology with skills, knowledge, and competencies that are common to all areas of professional psychology, NASP takes a different stance (Short, 2002). Specifically, to the extent that the practice of psychology within school settings is shaped as much by public policy and education legislation as it is by psychological principles, NASP asserts that school psychology may be viewed as a distinct discipline (Ball, Pierson, & McIntosh, 2011). The following sections overview training and credentialing standards emanating from both professional organizations, specific models of training, as well as recent legislative initiatives that have had an impact on the field of school psychology.

Training and Credentialing

Both NASP and APA have developed school psychology practice standards that provide a foundation for training and credentialing. Students receive training in graduate programs designed specifically to prepare school psychologists; school psychology training programs may be accredited by state education agencies, the APA (doctoral programs only), NASP, and/or the National Council for the Accreditation of Teacher Education (NCATE). Unlike clinical psychology and counseling psychology, which are doctoral-only fields, school psychology includes individuals with both master's or specialist degrees as well as doctoral degrees. NASP currently recognizes a 60-credit hour specialist degree (EdS) as the most appropriate level of training needed for entry-level, school-based practice.

Following training, school psychologists receive credentialing to practice in their respective states. The Department of Education certifies school psychologists to practice in school districts; this credential requires a master's- or specialist-level of training. For nonschool-based private practice, a doctoral degree is required by most states, and individuals must be licensed by a Board of Examiners in psychology. The following sections provide a summary of domains of competency in school psychology training as well as models of graduate training. A series of documents that continue to have a strong influence on training and credentialing, entitled *School Psychology: A Blueprint for Training and Practice*, are described first.

Blueprint for Practice and Training

In 1984, *School Psychology: Blueprint for Training and Practice* was published (Ysseldyke, Reynolds, & Weinberg, 1984). The original *Blueprint* and subsequent revisions (Ysseldyke et al., 1997; Ysseldyke et al., 2006) have continued to provide a framework for practice and training in school psychology and, as such, have had a significant impact on the profession. The nature of school psychology training and practice articulated in the *Blueprint* builds on the principles of psychology and education and the scientific method established by the 1949 Boulder (Rainey, 1950) and 1954 Thayer (Cutts, 1955) conferences. Many states incorporate the competency domains identified in the *Blueprint* into their licensing and certification standards. In addition, graduate training programs typically develop curriculum and competency standards that are directly aligned with the *Blueprint* domains.

The third edition of the *Blueprint* (published in 2006) includes both content and conceptual changes from the earlier versions. First, *Blueprint III* identifies eight competency domains, compared to 16 in the original 1984 *Blueprint*. Four domains (described later), called *foundational competencies*, encompass competencies that contribute to all areas of school psychology practice and constitute the foundation for the other four domains, called *functional competencies*, which comprise specific skills necessary to carry out the work of school psychology.

These domains are not intended to represent separate, isolated skills, but, instead, comprise an integrated set of competencies that require learning and developing over the course of one's career. A second change in *Blueprint III* is that service delivery is conceptualized within a multitiered model intended to meet the specific needs of the students and of systems serving children. Finally, *Blueprint III* underscores the importance of both academic and mental health factors that contribute to students' success, emphasizing that school psychologists need to focus on both aspects of students' development to promote long-term success in school.

Domains of Competency

School psychology programs ensure that prospective graduates acquire a knowledge base in both psychology and education, including theories, models, empirical findings, and technical skills across several competency domains. Through the most recent *Blueprint III* document, eight specific areas of competency have been established for school psychology; many training programs are designed to integrate these domains into their curriculum, practicum, and internship. The domains include both foundational and functional competencies. The four foundational competencies are: (1) *interpersonal and collaborative skills* to collaborate effectively with other educators, professionals, and caregivers to engage in planning and decision making at the individual, group, and system levels; (2) *diversity awareness and skills for sensitive service delivery* to work with individuals with diverse characteristics and to implement strategies that are adapted to accommodate individual characteristics, strengths, and needs; (3) *knowledge of technological applications* to be able to evaluate and utilize information sources and technology in ways that safeguard or enhance the quality of services; and (4) *professional, legal, ethical, and social responsibility knowledge* to be able to provide services to children, families and schools in ways that are consistent with public policy, legal guidelines, and professional standards. The four functional competencies include: (1) *data-based decision making and accountability skills* enabling school psychologists to use varied assessment methods as part of a systematic process to collect data and other information, to translate assessment results into data-based decisions about service delivery, and to evaluate the outcomes of services; (2) *skills for enhancing the development of students' cognitive and academic competencies* to develop, in collaboration with others, appropriate cognitive and academic goals for students with varying abilities, disabilities, strengths, and needs; to design and implement interventions to achieve those goals; and to evaluate the effectiveness of interventions; (3) *skills for enhancing the development of students' wellness, social skills, mental health, and life competencies* to develop appropriate behavioral, affective, adaptive, and social goals for all students; design and implement appropriate interventions; and evaluate intervention effectiveness; and (4) *skills for systems-based service delivery skills* to work with individuals, groups and systems to facilitate policies and practices that create and maintain safe, supportive, and effective learning environments for children (Ysseldyke et al., 2006).

Drawing on the *Blueprint* standards as well as other resources related to school psychology, NASP has developed (and recently revised) standards for training and practice (NASP, 2010c). The NASP standards describe competencies needed by school psychologists to effectively support learning and mental health development of children and youth and to promote school success for all learners. The standards identify 10 overlapping and interrelated domains of competencies. Within the NASP model of comprehensive and integrated services, school psychologists are expected to demonstrate both knowledge and skills across all 10 general domains (NASP, 2010a). Specifically, the competency domains include: (1) data-based decision making and accountability; (2) consultation and collaboration; (3) interventions and instructional support to develop academic skills; (4) interventions and mental health services to develop social and life skills; (5) school-wide practices to promote learning; (6) preventive and responsive services; (7) family-school collaboration services; (8) diversity in development and learning; (9) research and program evaluation; and (10) legal, ethical, and professional practice.

Models of Training

Two levels of graduate education are prominent in school psychology. The specialist level typically involves 2 years of full-time study, the completion of approximately 60 graduate-level credits of coursework, and a full-time internship during the third year of study. Specialist-level programs are frequently aligned with NASP graduate program standards. Graduates of specialist-level programs typically work in public school settings (Merrell et al., 2006). The second level of training occurs at the doctoral level and requires 4 to 6 years of full-time study, a 12-month internship, and an additional year (often following the internship year) to complete a dissertation. In contrast to specialist-level training, doctoral school psychology programs align themselves more with the APA accreditation standards than with NASP training standards.

Graduates of doctoral programs may work in a variety of school and nonschool-based settings, including community mental health centers, hospitals, and clinics, as well as in research or university settings (Merrell et al., 2006).

Graduate training in school psychology typically follows one of three models of training. The Boulder model (scientist-practitioner) is the traditional training model and culminates in the PhD (Doctor of Philosophy) degree in psychology. The Boulder model aims to produce psychologists who are active in both generating and utilizing psychological research and in providing psychological health services. The Vail model of training (practitioner-scholar) was developed in the 1960s as an alternative to the Boulder model and leads to the PsyD (Doctor of Psychology) degree. School psychologists trained in accordance with the Vail model are more often prepared to provide psychological health services and to understand psychological research, but they usually are not prepared to conduct research themselves. Each practice and training models in school psychology is summarized below.

Scientist-Practitioner

The scientist-practitioner model is a training model for graduate programs that focuses on creating a foundation of research and scientific practice. The goal of the training, educational model, and eventual practice is for clinicians to use scientific methodology in their practice; to work with clients using empirically-validated methods, tools, and techniques; to inform their clients of scientifically-based findings and approaches; and to conduct practice-based research.

Practitioner-Scholar

The practitioner-scholar model is focused predominantly on clinical practice. Within this model, a psychologist is a viewed as scholar, consumer of research, and highly trained professional practitioner who applies knowledge and techniques to solve problems of clients. Training within this perspective is more strongly focused on clinical practice compared to the other models. Similar to scientist-practitioner training, practitioner-scholar training is characterized by core courses in both basic and applied psychology, supervision during extensive clinical experience, and research consumption.

Scientist-Practitioner-Scholar

The scientist-practitioner-scholar model of training aims to integrate elements of both the scientist-practitioner and the practitioner-scholar models as a comprehensive approach to training. The scientist component consists of understanding the central tenets of research, whereas the practitioner aspect emphasizes the application of findings from research. Finally, the scholar element focuses on understanding and developing theories that guide research and influence practice (Kratochwill, Gettinger, Reynolds, & Doll, 1988).

Professional Organizations

Throughout the history and development of school psychology, professional organizations have served to represent the interests of school psychologists as well as to regulate the profession through training and credentialing standards. Three professional organizations, in particular, have addressed the research, training, and practice interests and concerns of school psychology.

American Psychological Association, Division 16

The Division of School Psychology (Division 16) was one of the original divisions created in 1945 within the American Psychological Association. Division 16 supports psychologists who engage in providing comprehensive psychological services to children, adolescents, and families in schools and other applied settings. The division strives to support the professional practice of school psychology and actively advocates in critical domains, such as education and health care reform, which have significant influence on the practice of school psychology. Throughout its history and because of its affiliation within the APA, Division 16 has advocated for doctoral training as the entry-level preparation for school psychologists (Clay, 2010). Since the 1950s, Division 16 has been instrumental in supporting and convening major conferences related to the continuing development and expansion of professional school psychology, including the Thayer Conference in 1954, Spring Hill Symposium in 1980, Olympia Conference in 1981, and, most recently, the Conference on the Future of School Psychology in 2002 (Dawson et al., 2004).

National Association of School Psychologists

The National Association of School Psychologists (NASP) is a professional organization designed to inform school psychologists, educators, and school psychology trainees about best practices, professional competencies, and current topics relating to the practice of school psychology. The goals of NASP include professional competency, advocacy, diversity, and effective relationships and communications (NASP, 2007). NASP was founded in 1969 to better represent the interests of school psychologists than Division 16, particularly those trained at the nondoctoral, or specialist, degree level. In addition, NASP was established in response to a need to organize activities, coordinate efforts, and build communication among the existing state-level school psychology associations across the country (Fagan, 1994). Currently, NASP has a membership of more than 22,000, making it the largest national organization directed exclusively to school psychology.

Society for the Study of School Psychology

The Society for the Study of School Psychology (SSSP) was created from the group that established the *Journal of School Psychology* in the early 1960s. The SSSP was converted to a nonprofit organization with the intent to provide resources that would benefit the profession of school psychology. SSSP has a unique role among school psychology organizations as it is devoted entirely to promoting and recognizing scholarship and research. Membership in the society is small (about 90 members currently) and by nomination. The goals of the SSSP include providing research funding (particularly to young researchers), validating effective practice, and expanding the scope and effectiveness of school psychological services.

Publications

Several scholarly journals, books, and professional newsletters publish empirical studies and comprehensive reviews to inform research and practice in school psychology. Prior to the 1960s, the Division 16 newsletter was the only publication devoted exclusively to school psychology. The 1960s witnessed tremendous growth in the number of journals in school psychology, including the *Journal of School Psychology* (the journal of the SSSP), *Psychology in the Schools*, and *Professional Psychology*. In 1969, NASP established a monthly newsletter (the *Communiqué*) and, in 1972, published the *School Psychology Digest* (now *School Psychology Review*). Beginning in the 1980s, NASP shifted toward publishing a large number of books and manuals related to school psychology practices. Among the most successful NASP publications include the *Best Practices in School Psychology* series (five editions), *Children's Needs* (three editions), and *Interventions for Academic and Behavior Problems* (three editions). For its part, in 1986, Division 16 began publishing *Professional School Psychology* (now *School Psychology Quarterly*); the Division 16 newsletter, *The School Psychologist*, is published quarterly. In addition to the publications of the SSSP, NASP, and Division 16, other scholarly journals relating to school psychology research and practice include *School Psychology International*, *Journal of Psychoeducational Assessment* (Sage), *Special Services in the Schools* (now *Journal of Applied School Psychology*). Finally, several edited volumes on school psychology have been published over the past 30 years, notably the *Handbook of School Psychology* (currently in its fourth edition), that provide valuable resources for school psychology.

Legal and Ethical Influences

In addition to professional organizations and publications, numerous legal and ethical statutes also serve to guide school psychology practice. In particular, the profession is heavily influenced by state and federal legislation relating to education. One widely recognized educational law is the *No Child Left Behind Act* (2001), which was an amendment to the Elementary and Secondary Education Act of 1965 (Merrell et al., 2006). The NCLB act requires each state to develop challenging academic content standards; conduct yearly student assessments in mathematics, reading, and science; and establish measurable achievement standards expected of all children in the academic domain. The public scrutiny that schools face when they fail to make "adequate yearly progress," combined with the recognition and financial recourses that are provided to high-scoring schools, has sometimes resulted in schools attempting to inflate scores by placing more children in special education, retaining more students, and/or identifying more children as limited English proficient (Allington & McGill-Franzen, 1992). School psychologists are often called on to combat these practices by identifying reasonable test accommodations for students with disabilities, assisting in the evaluation of district goals and curricula, promoting effective instructional practices, and consulting with teachers to improve students' test-taking skills (Braden et al., 2001). In addition to targeting proficiency in mathematics, reading, and science for all students, two additional goals of NCLB are to promote high school graduation for students and to establish safe and drug-free schools. These goals have resulted in school psychologists being directly involved in developing and implementing school-wide dropout and violence prevention programs (Curtis, Costello, & Cohen, 2008).

Another federal law that directly affects the practice of school psychologists is the *Individuals with Disabilities Education Improvement Act*, the 2004 reauthorization of the *Individuals with Disabilities Improvement Act* (IDEA). In accordance with IDEA, special education and related services are designed to meet the unique learning needs of children with disabilities in preschool through age 21. Two major changes that occurred through the 2004 reauthorization of IDEA, in particular, have had a significant impact on school psychology practice. First, schools are allowed to allocate up to 15% of their special education funds specifically for early intervention services. This has resulted in greater resources and more opportunities for school psychologists to be directly involved in prevention, intervention, and systems-level changes. Second, with the reauthorization of IDEA, the eligibility criteria for specific learning disability (SLD) were revised to encourage schools to implement response-to-intervention models, instead of a test-based discrepancy model, to determine SLD eligibility. This revision has resulted in a drop in the need for school psychologists to conduct individual special education evaluations, allowing them to engage in activities related to data-based decision making, planning and evaluating evidence-based instruction, and implementing supplemental interventions with small groups or individual students (Jacob & Hartshorne, 2007). In sum, whereas the “gatekeeper” role for school psychologists was perpetuated by the need to test children to determine special education eligibility, the reauthorization of IDEA has created new opportunities for school psychologists to be more directly involved in service delivery designed to prevent special education placement.

Beyond adhering to legislative influences and mandates, school psychologists are expected to adhere to ethical standards when working with children, families, and other professionals. Ethical codes dictate appropriate and expected conduct in professional activities. As with all areas of psychological practice, violations of ethical codes may result in being dismissed form professional organizations and/or having one’s credential revoked. Similar to training and practice standards, schools follow ethical guidelines developed by both NASP and APA. NASP’s formal principles of conduct are outlined in the publication, *Principles for Professional Ethics* (NASP, 2010b). NASP’s ethical principles are based on the assumptions that school psychologists act as advocates for their students/clients, and, at the least, will do no harm. This document describes guiding principles for ethical conduct regarding professional competency, professional relationships, professional practices, and independent practice.

The APA has a parallel document that guides ethical behavior for school psychologists, entitled the *Ethical Principles of Psychologists and Code of Conduct* (APA, 2002). This document describes five general principles of ethical practice in psychology, including (1) beneficence and nonmaleficence, (2) fidelity and responsibility, (3) integrity, (4) justice, and (5) respect for people’s rights and dignity (APA). The ethical standards provided by NASP and APA are integral sources of guidance for psychologists regarding professional conduct.

SCHOOL PSYCHOLOGY AND ASSESSMENT

School psychology research and practice is focused on understanding children and promoting their educational, social-emotional, and behavioral development. As such, assessment and measurement have been the foundation for school psychology and continue to be central components of school psychology training and expertise (Kaufman, 2000). Significant changes in general and special education law in recent years have had major implications for the practice of school psychology, particularly with respect to assessment and psycho-educational evaluations (Kavale & Flanagan, 2007). Despite these changes, assessment continues to be an integral component in school psychology practice. In the following sections, traditional, standardized testing methods as well as more contemporary approaches to assessment within school psychology are described.

Standardized Testing

School psychology has a long history of expertise related to individually administered, standardized assessment, including IQ tests and other measures of cognitive functioning and academic achievement (Kehle, Clark, & Jenson, 1993). Prior to the reauthorization if IDEA, eligibility criteria for specific learning disability depended heavily on the use of both standardized intelligence measures and academic achievement tests (Osgood, 1984). Even with recent changes in the legal requirements for the identification of students with learning disabilities, including movement away from documenting an IQ-achievement discrepancy for eligibility determination, there is still a need for traditional test-based assessment. For example, the use of intelligence testing remains a required component for determining cognitive disabilities and developmental delay (Flanagan, Ortiz, Alfonso, & Dynda, 2008).

In school-based assessment practices, tests of cognitive abilities, including intelligence tests, are administered to gather information about a student’s strengths and weaknesses. Cognitive ability tests are normative, standardized measures that yield information about a student’s performance relative to other children at his or her age or grade level. The way in which a student performs overall on intelligence tests and on specific tasks that comprise different scales or subtests, purportedly, provides information regarding how she or he processes information (Braden & Shaw, 2009). As such, a measure of cognitive ability may serve as a starting point in conducting further assessment or considering components to include in interventions. Indeed, many school psychologists continue to support the utility of cognitive abilities testing as the basis for educational decision making beyond special education eligibility (Braden & Shaw, 2009; Bramlett, Murphy, Johnson, Wallingsford, & Hall, 2002). Surveys conducted as recently as within the past 5 years indicate that a high percentage of school psychologists use IQ tests when conducting assessments of individual children referred for learning challenges, not necessarily for special education evaluation (Rees, Rees, & Farrell, 2006; Restori, Gresham, & Cook, 2008; Wnek, Klein, & Bracken, 2009; Worrell, Skaggs, & Brown, 2006). Moreover, surveys also indicate that the many teachers perceive the primary role of school psychologists as conducting individual assessments of referred children, using primarily IQ measures (Watkins, Crosby, & Pearson, 2001).

There have been ongoing debates in the professional literature about the relevance of IQ testing in the assessment of children who are experiencing learning difficulties (Burns & Coolong-Chaffin, 2006). Because the concerns surrounding IQ testing are addressed more thoroughly in other publications (e.g., Daniel, 1997; Fish, 2002; Howe, 1998; Snyderman & Rothman, 1990), only the primary issues are highlighted here. Critics of school psychologists' reliance on intelligence tests make compelling claims to argue against the utility of such tests (Reschly & Grimes, 2002). Essentially, the most critical concern is that information derived from IQ tests (individual subset scores, composite test scores, or cognitive profiles based on score patterns) contributes little to understanding children's learning problems and have limited utility for intervention planning or evaluation of treatment effectiveness. Torgeson (2002), for example, concluded that there is little scientific evidence that processing strengths or weaknesses as determined by performance on an IQ test relate to children's academic performance. Restori, Gresham, and Cook (2008) synthesized findings from several research studies to argue that neither IQ scores nor cognitive profiles derived from subscale analysis are helpful in diagnosing learning problems or planning effective interventions. In addition, opponents of school psychologists' reliance on IQ tests argue that intelligence test scores can be misinterpreted and lead to lowered expectations for children, particularly children from low-income and minority backgrounds who typically perform lower on such measures than their peers from higher income and non-minority backgrounds (Rogers et al., 1999). Moreover, because measures of cognitive functioning vary in the manner in which intelligence is defined and measured, results can vary across standardized tests and reflect different abilities (Stuebing et al., 2002).

Despite evidence that neither full-scale IQ scores nor an analysis of cognitive profiles is helpful in planning interventions, school psychologists may claim there are other legitimate reasons for including a measure of cognitive ability in their overall assessments (Braden & Shaw, 2009). Information derived from cognitive ability testing contributes to an understanding of possible reasons for a student's success or failure and, as such, is useful for generating and testing hypotheses about performance (Jiminez, Siegel, O'Shanahan, & Ford, 2009). Experienced test administrators can gain insights into a child's problem-solving skills or organizational abilities by observing the manner in which she or he approaches novel tasks on an IQ test. Indeed, proponents of cognitive ability testing argue that an analysis of children's cognitive strengths and weaknesses can be helpful for intervention planning. The way a child thinks and approaches learning is relevant to understanding their learning difficulties (Dehn, 2006). For example, in a recent meta-analysis, the National Early Literacy Panel (2009) concluded that phonological awareness, verbal memory, and rapid automaticized naming are examples of cognitive abilities that are highly predictive of children's success in reading that can be evaluated through standardized assessment procedures.

In light of both the pros and cons surrounding standardized testing, best practice guidelines for school psychology recommend that cognitive assessment tools should be used only when the results are directly relevant to specific referral questions regarding cognitive abilities and should always be part of a multifactored, multimethod assessment approach that is matched to the individual characteristics of children (e.g., language, culture, behavior) (Flanagan et al., 2008). In fact, current test manuals for measures of cognitive ability encourage school psychologists to give weight to scores from other measures and assessment procedures.

Several tests to measure cognitive abilities have been developed since Binet's work in 1905 and are commonly used by school psychologists. Of these, the *Wecshler Intelligence Scale for Children* (Wechsler, 2003, now in its fourth revision) and the *Stanford-Binet Scales of Intelligence* (Roid, 2003, now in its fifth revision) are reported to be most often used by psychologists in schools. Additional major batteries include the *Kaufman Assessment Battery for Children* (A. Kaufman & Kaufman, 2004, currently in its second version), the *Woodcock-Johnson Psychoeducational Battery* (Woodcock, McGrew, & Mather, 2001, now in its third revision), and the *Differential Ability Scales* (Elliott, 2007, in its second revision).

Until 2000, the majority of these tests of intelligence were considered to be atheoretical in the sense the test items and scales were not necessarily derived from theories of cognitive development or information processing. As noted by Flanagan et al. (2008), all of the major tests identified above have undergone revisions since 2001, with the common aim of developing revised measures that are more firmly rooted in contemporary psychometric theories. Recent advances in current theory and research on the structure of cognitive abilities have resulted in an empirically derived model referred to as the Cattell-Horn-Carroll (CHC) theory (McGrew, 2005), which is represented in the underlying structure of the majority of the current versions of tests of cognitive ability. CHC theory of cognitive abilities is actually an amalgamation of two similar theories about the content and structure of cognitive abilities. The first of these two theories is Gf-Gc theory (Cattell, 1941; Horn, 1968), which posited a dichotomous conceptualization of cognitive ability including fluid intelligence (e.g., reasoning abilities) and crystallized intelligence (e.g., stored knowledge). The second is Carroll's (1993) three-stratum theory, which conceptualizes cognitive ability in terms of three strata that differ in breadth and generality of abilities. CHC theory is the most comprehensive and empirically supported psychometric theory of the structure of cognitive and academic abilities and has been the foundation for test development and revision since in the last decade.

Contemporary and Alternative Assessment Practices

New federal legislation coupled with recent reform initiatives designed to move schools toward adopting prevention-oriented service delivery models have necessitated the development of alternative assessment practices. Increasingly, schools rely on curriculum-based assessment to guide prevention and early intervention for academic skill problems. There has also been a growing emphasis on the use of functional behavioral assessment to facilitate the development of effective interventions to address children's behavioral and social-emotional challenges. These changes have increased the need for school psychologists to demonstrate competence in both types of assessment practices.

Curriculum-Based Assessment

Curriculum-based assessment (CBA) includes measures of academic performance that are increasingly being used as an alternative to or in conjunction with norm-referenced, standardized tests to make appropriate decisions regarding students' educational needs. The increased use of CBA methods is linked to several advantages they provide over standardized tests. First, unlike norm-referenced tests, CBA methods are based on or developed directly from the local instructional curriculum to assess students' basic skills in core academic content areas, such as reading, mathematics, spelling, and writing (Shapiro, 2004; Shapiro & Elliott, 1999). As a result, a child's performance on CBA is directly linked to the curriculum and instruction he or she is receiving in the classroom, thus allowing for the identification of specific curricular skill deficits, the corresponding areas of instruction and intervention that should be targeted to remediate such deficits, and the appropriateness of the child's instructional placement (Hintze, Christ, & Methe, 2006; VanDerHeyden & Burns, 2005).

A second advantage of CBA is that measures can be repeatedly administered, without producing practice effects, to evaluate both short- and long-term changes in a child's academic performance (Fuchs & Deno, 1991; Shapiro, 2004; Shapiro & Elliott, 1999). As such, CBA measures are effective for (a) screening all students to identify those at-risk for academic failure and evaluate the effectiveness of classroom curricula and instruction, (b) monitoring an individual child's progress toward academic goals across time, and (c) evaluating the effectiveness of small-group and individualized instructional adaptations, modifications and interventions (Hintze et al., 2006). Finally, compared to standardized tests, CBA probes are relatively easy to develop and/or acquire, inexpensive, time-efficient in both administration and scoring, easily interpreted, and require minimal training to administer (Hosp, Hosp, & Howell, 2006). Due to these characteristics, CBA is an integral part of current models of service delivery and serves as an appropriate alternative method to the ability-achievement discrepancy model for identifying children with learning disabilities (Deno, 2003).

Despite common characteristics, there are different types of CBA measures that vary in terms of the degree of specificity of the curricular content that is sampled and the actual methods used to assess a child's skills (Fuchs, 2004; Hintze et al., 2006; Hosp et al., 2006). All approaches to CBA, however, fall into one of the two major models: general outcome measurement (GOM) models and specific subskill mastery (SSM) models (Fuchs & Deno, 1991). The primary objective of GOM is to assess a broad range of skills within an academic content area to evaluate long-term growth toward curricular outcomes. Curriculum-based measurement (CBM) is the most commonly used and research-supported type of GOM (Shapiro, 2004). CBM uses standardized procedures and equivalent grade-level measures that allow for frequent monitoring of students' progress toward long-term skill obtainment, as well as development of local norms to allow for individual and group comparisons of assessment scores (Deno, 2003). As such, CBM probes are used to determine whether students are acquiring skills at the necessary rate for meeting long-term classroom-, school-, and district-level academic objectives. Because probes assess a broad range of academic skills, CBM data do not specify the skills that contribute to low skill attainment. Thus, CBM data are limited in the degree to which specific instructional interventions required for remediation can be prescribed.

In contrast, the second major type of CBA, SSM, includes measures that are nonstandardized and typically developed to assess discrete subskills or short-term objectives currently being taught within the curriculum (Hintze et al., 2006). As a result, SSM data may have a higher degree of treatment utility compared to GOM (Shapiro, 2004). For example, in the assessment of reading achievement, CBM can provide data regarding a child's skills in the broad area of reading fluency and indicate whether the child's reading fluency is typical for his/her grade level. SSM measures, however, can assess the specific subskills needed to read fluently, such as the ability to identify basic sight words (see Hintze et al., 2006, for an example). Overall, both approaches to CBA provide valuable assessment information that contributes to an improved understanding of students' academic achievement within the classroom.

Functional Behavioral Assessment

Functional behavioral assessment (FBA) is a procedure used by school psychologists to gain an understanding of children's challenging behaviors for purposes of guiding intervention-planning. The focus in FBA is on identifying environmental contexts or events that "trigger" the occurrence of challenging behaviors. This perspective is intended to offer an understanding of the function or purpose underlying students' misbehavior. Because FBA has the potential to lead directly to interventions, school psychologists find that this approach has significantly greater utility for intervention planning than many other assessment methods, such as scales of social-emotional functioning (Chandler & Dahlquist, 2009). Intervention plans derived from FBS have been shown to be effective in addressing a wide range of social-emotional and behavioral problems as well as academic learning problems (Waller, 2008).

Although functional assessment is typically applied to behavior problems, it can also be helpful in addressing academic issues (e.g., Daly, Witt, Martens, & Dool, 1997). For example, using a functional assessment approach, plausible hypotheses about why students perform poorly can be derived empirically. Within a functional perspective, it may be hypothesized that a low-performing student (a) is not motivated to complete the work, (b) has not spent sufficient time engaged in completing work, (c) has not received adequate support or instruction to be able to complete work, (d) does not understand the directions for completing school work, or (e) does not have the necessary skills or background knowledge (Daly et al., 1997).

The goals of FBA are to (a) identify and define the behavior of concern, (b) identify antecedents of the target behavior, (c) determine the possible functions of behavior, and (d) select "replacement" behaviors to strengthen (Gresham, Watson, & Skinner, 2001). Three types of measurement procedures for conducting FBA are typically implemented by school psychologists, either in isolation or within a comprehensive assessment approach, to achieve these goals (Watson & Steege, 2003). Indirect procedures include interviews (with teachers, parents, children, or other school personnel), records reviews, and rating scales to generate hypothesis about the function of the child's behavior. Direct procedures include systematic observations to identify antecedents, consequences, and settings or contexts within which the behavior occurs. Finally, to confirm hypothesis about the function of challenging behaviors, a experimental functional analysis may be conducted, in which the child's behavior is systematically observed under different conditions that simulate the hypothesized antecedents or contexts (e.g., work that is difficult) that trigger behavior (Chandler & Dahlquist, 2009).

CURRENT PERSPECTIVES ON SCHOOL PSYCHOLOGY SERVICE DELIVERY

Several recent perspectives on school psychology service delivery have resulted from the policy and legislative influences described above; they are also reflected in the APA and NASP guidelines regarding the definition, roles, and competencies related to school psychology practice. These current perspectives grew out of increasing concerns within the profession with traditional “refer-test-place” models of service delivery and the need to consider alternative approaches to meet the growing number and complexity of learning and mental health problems faced by students today (Crockett, 2004). Perhaps more than any other specialty area in psychology, school psychology has been the focus of ongoing discussions within the professional literature regarding the role of school-based practitioners in addressing academic, behavioral, and social-emotional problems (Bradley-Johnson & Dean, 2000). Calls for a change in the role of school psychologists to move beyond assessment converge on recommendations for school psychologists to be involved in data-based decision making, with a greater emphasis on multitiered intervention and prevention of school-related problems, more consistent application of scientifically based research in identifying and designing effective interventions, involvement in indirect service delivery and problem solving, and heightened sensitivity to the cultural and linguistic diversity of school-age populations (Ball et al., 2011; Dawson et al., 2004; NASP, 2007; Reschly, 2000; Sheridan & Gutkin, 2000).

Data-Based Decision Making

Data-based, or data-driven, decision making is a core element of school-based interventions. Experts agree that effective school psychology practice is data-based; that is, school psychologists base decisions on valid and reliable data, and they use effective data collection procedures to inform, monitor, and modify intervention activities, as needed. Data-based decision making involves gathering, analyzing, and utilizing student performance data (e.g., achievement test data, progress-monitoring data, attendance, disciplinary office referrals) to design appropriate instructional and intervention plans for students, often in the context of school-based, problem-solving teams. Two widely recognized service delivery models that rely heavily on data-based decision making are Response-to-Intervention (RtI, discussed further on) and School-Wide Positive Behavior Interventions and Supports (SWPBIS). In both of these service delivery models, data warehouse software systems (e.g., AIMSweb, School-Wide Information System [SWIS]) are used to store students’ information, analyze data, and generate reports for decision-making purposes. Through collaborative analysis of data, decisions are made in an effort to make the school or classroom environments effective for all students.

Data-based decision making is also inherent in the development of student evaluation and educational programming for special education services. Prior to the formal Individual Educational Program (IEP) meeting, baseline data are gathered by school psychologists and other team members. These data are used to analyze the discrepancy between the student’s actual level of performance and the expected level of performance given the child’s age and disability level. If a student is found to have a disability, then the student’s IEP is tailored to meet the needs of the individual student with specific, measureable, and attainable goals. Specific interventions are implemented, and progress in monitored to assess intervention effectiveness and implementation integrity. Whereas federal educational legislation requires that IEPs are reviewed yearly, best-practice guidelines call for ongoing (e.g., weekly, monthly) and systematic evaluation of progress toward specific goals.

Response-to-Intervention Models

Special education was developed based on the notion that individualized or small-group instruction, tailored to meet the needs of students, could increase academic performance among low-achieving students (Fagan, 2002). Historically, special education has not successfully closed the performance gap between typically achieving and low-achieving students. In response to concerns with the current status of special education, an approach termed response-to-intervention (RtI) has been developed to identify children with academic or behavioral challenges early on and, subsequently, to implement and monitor evidence-based interventions to prevent long-term failure. While retaining a focus in school psychology on student assessment through universal screening and ongoing progress-monitoring, RtI has had its most significant impact on prevention and intervention activities of psychologists working in schools (Barnett, Daly, Jones, & Lentz, 2004; Fuchs, Mock, Morgan, & Young, 2003). Specifically, RtI represents a prevention-oriented approach that relies on data-based decision making to plan and implement interventions that target the curriculum, instruction, school and home learning environment, teacher behaviors and interactions, as well as learner characteristics (Witsken, Stoeckel, & D’Amato, 2008).

Through the application of an RtI model, schools use screening and assessment tools to identify students who may be at risk for poor learning outcomes or behavior problems. RtI emphasizes using high-quality instruction and evidence-based interventions to address students’ needs, monitoring student progress, and adjusting the intensity and nature of the interventions depending on a student’s responsiveness to these various levels of interventions. In this way, data-based decision-making is inherent within an effective RtI service delivery model. Targets and goals for instruction or intervention are specified using benchmark assessments that are administered to the entire student body, typically three times a year (fall, winter, spring). Additionally, CBM progress-monitoring data are used to monitor student's performance and intervention adherence. Students' response to a given level of intervention/instruction is used to make decisions regarding the student's movement to another level or tier of intervention (Kratochwill, Albers, & Shernoff, 2004; Kratochwill, Volpiansky, Clements, & Ball, 2007).

Typically, RtI models include three levels or tiers of instruction and intervention. Tier 1 (also referred to as the primary or universal level) embodies the core curriculum and is provided to all students within each grade-level and on a school-wide basis. In theory, Tier 1 instruction and/or behavioral programming are intended to meet the needs of 80% of the student population. Interventions or programs at Tier 2 (also referred to as the selected or secondary level) are designed to meet the needs of the 10% to 15% of the student population who do not respond to the universal curriculum, based on universal screening or benchmark testing. Tier 2 interventions are typically implemented in the classroom to small groups of students (2 to 6) for 20 to 30 minutes, multiple times a week. Most importantly, the level of intervention within Tier 2 is designed to be supplemental to (not in place of) the universal curriculum. Lastly, Tier 3 interventions (also referred to as the targeted, intensive, or tertiary level) are designed to meet the needs of the 1 to 5% of students with the greatest need for support. Academically, Tier 3 students fail to make making adequate progress (despite receiving small-group Tier 2 interventions and high-quality Tier 1 instruction) as indicated by benchmark and continuous progress-monitoring data. In relation to social-emotional and behavioral concerns, students in need of Tier 3 services are those who continue to exhibit challenging and maladaptive behaviors (e.g., fighting with other students, relational aggression, attention issues) despite participating in evidence-based Tier 1 and 2 instruction and interventions.

Evidence-Based Practice

Knowledge about school-based interventions and instructional practices that are effective in promoting academic success has expanded significantly over the past decade. This growing knowledge base has paralleled a strengthened commitment among researchers and policy makers to translate research findings about effective practices into schools and classrooms. Adopting a scientific approach to addressing school problems is at the core of a scientist-practitioner model and has fueled the evidence-based practices (EBP) movement within both psychology and education. Within an EBP approach, the development and selection of interventions are guided by empirical research and, in turn, interventions are evaluated through systematic data collection and analysis of outcomes. In recent years, the EBP movement has gained momentum and drawn attention from individuals, groups, and associations in the field of education because of the emphasis on scientifically based instruction in federal laws and regulations (IDEA and NCLB) and because evidence-based practice is integral to the implementation of RtI models. In general, EBP refers to the use of mental health, behavioral, and educational interventions for which systematic empirical research has provided evidence of statistically significant positive effects. In recent years, EBP has been stressed by professional health care organizations, including APA. The APA Presidential Task Force on Evidence-Based Practice (2006), for example, specifically defines evidence-based practice in psychology as the "integration of the best available research with clinical expertise in the context of patient characteristics, culture, and preferences" (p. 273).

In applying this definition to school-based practice, it requires that school psychologists concern themselves with instruction and interventions that have strong research support *and* have demonstrated effectiveness in applied school settings (Kratochwill & Shernoff, 2004).

Within the field of school psychology, Division 16, NASP, and SSSP collaborated through the establishment of the Task Force on Empirically-Supported Interventions in Schools. The Task Force identified evidence-based interventions to address behavioral, emotional, and academic needs of children in school settings (e.g., Kratochwill & Shernoff, 2004; Kratochwill & Stoiber, 2000, 2002; Stoiber & Kratochwill, 2000). The ultimate goal of the Task Force has been to promote the use of evidence-based interventions by improving the quality of research training, developing evaluation criteria for evidence-based interventions, and reporting this information to the profession (Kratochwill & Shernoff, 2004).

Despite recent calls for EBP, there are challenges related to the widespread dissemination and implementation of research-supported practice. Numerous authors (Hoagwood & Johnson, 2003; Kratochwill & Shernoff, 2004) describe a research-to-practice gap, or disconnect between research findings and practice settings; these individuals identify a need to develop evidence-based assessments and interventions that are both effective and feasible for practitioners. Hoagwood and Johnson (2003), for example, proposed that a new era of school psychology research that focuses on intervention implementation and factors that impede or promote implementation. According to Hoagwood and Johnson, stronger collaboration between researchers and practitioners is warranted. An additional mechanism for dissemination of knowledge of EBP is through reviews and meta-analyses prepared by agencies and organizations that can be used for easy-access information for practitioners. For example, in 1997, the National Reading Panel (NRP) convened to assess the effectiveness of different approaches used to teach children to read. The result of the work of the NRP was published in 2000 and has served as a major source for EBP in reading instruction (NRP, 2000). As another example, in 2002, the U.S. Department of Education funded a major project called the *What Works Clearinghouse* (WWC; see www.whatworks.ed.gov/). The WWC is a quick reference web source that lists evidence-based instructional programs and approaches in various content domains.

Problem-Solving Consultation

One of the most important and distinctive types of service provided by psychologists working within school settings is consultation. In general, consultation is indirect service delivery to children in that psychologists consult with teachers, families, and other professionals to enable them to address the needs or concerns of individual students and to improve the overall learning environment for all students. The ultimate goal of consultation is to bring bout positive changes within teachers, classroom environments, and school settings to promote success among all students. Through the years, multiple school-based consultation models have been described in the literature, most notably, mental health consultation (Caplan, 1970), behavioral consultation (Bergan & Kratochwill, 1990), and instructional consultation (Rosenfield, 1987). In addition to the common emphasis on indirect service delivery, a hallmark of all consultation models is the utilization of a problem-solving process to address student or teacher concerns.

Kratochwill (2008) defined problem-solving consultation as “a model for delivering assessment, prevention, and intervention services to children and schools via consultees through a series of structured meetings” (p. 1676). Through multiple structured meetings, the consultant (school psychologist) and the consultee (teacher) progress through a series of stages or phases with specific objectives and goals. To achieve a successful consultative process, both the consultant and consultee function in accordance with collaboratively determined roles. The consultant, for example, acts as a facilitator, elicits a description of the problem, assists in analyzing the problem, co-constructs a plan for intervention, and establishes a monitoring system once the program is implemented. The consultee’s role, in turn, is to work with the consultant by describing the identified problem, assisting with intervention conceptualization, and monitoring the intervention by observing progress (or lack of progress) and notifying the consultant.

Within a problem-solving perspective, school psychologists shift from being diagnosticians toward being more integrally involved intervention planning, primarily through consultation with teachers and other professionals (Feldman & Kratochwill, 2003). Although the implementation of problem-solving consultation can vary across schools and problem types, the process typically revolves around five stages. The major objectives of each of the five stages of problem-solving consultation are described below.

Stage 1: Establishing Relationships

The development of a positive, interpersonal relationship between the psychologist and the consultee is critical for effective consultation. To maximize consultant-consultee effectiveness, the consultant must establish trust and convey respect for and sensitivity to the issues that are relevant and important to the consultee. Additionally, an effective consultant acknowledges the consultee’s unique skills and contributions to the problem-solving process.

Stage 2: Problem Identification

During the problem identification stage, the consultant and the consultee operationally define and describe the problem behavior(s). The definition of the problem includes the frequency, duration, and intensity, as well as, the conditions under which the problem behavior(s) are occurring. A problem is determined to exist when there is a discrepancy between the student’s actual performance (academic, social-motional, and/or behavioral) and the desired level of performance dependent on child age and disability. Once a discrepancy is ascertained, the psychologist and consultees identify the skills or competencies needed to address the concern in order to alleviate the discrepancy (e.g., active listening skills, basic math skills, physical therapy). Also within this stage of problems-solving, assessment methods are determined that will be used to screen and assess baseline and intervention outcomes.

Stage 3: Problem Analysis

The third stage in the problem-solving consultation entails the identification of factors contributing to the problem. Questions about who, what, where, when, and under what circumstances are important leading questions to be discussed and assist with the identification of antecedent and consequent events. During this stage, the school psychologist may gather additional data to redefine the problem behavior(s). In sum, accurate and valid problem analysis is complete when the environmental and/or student characteristics that contribute to the problem behavior are identified and procedures have been established to evaluate student performance during the implementation of an intervention program.

Stage 4: Plan Implementation

Two objectives are critical during the plan implementation stage of the problem-solving consultation process. The first objective is to select an evidence-based and developmentally appropriate prevention or intervention program. It is important to consider factors that influence treatment adherence and integrity, including child, teacher, treatment, and organizational variables that may impede the successful implementation of the chosen evidence-based intervention(s). The second objective is to discuss and implement the selected intervention, as well as collect progress-monitoring data. Prior to carrying out the intervention, the psychologist should ensure that the teacher (or other change agent) has been trained to implement the targeted intervention and administer the progress-monitoring procedures. During this stage, the psychologist monitors the implementation process (ensuring treatment adherence and integrity) and plans revisions, accordingly.

Stage 5: Plan Evaluation

The final stage of the problem-solving process is evaluation. During this stage, the psychologist evaluates the effectiveness of the intervention through an analysis of the progress-monitoring data collected during the plan implementation stage. Most importantly, the consultant and consultee(s) review the previously established goals and determine the extent to which they have been achieved. Plans for revising the goals or intervention and for maintenance and generalization across multiple settings are also developed, as needed.

Culturally Responsive Practice

The United States is currently experiencing rapid and unprecedented changes in the demographic makeup of its population, including an influx of individuals whose native language is not English. It has been estimated that by the year 2050, the Latino population will be the largest minority group in the United States and that individuals of Anglo-European heritage will constitute only 50% of the U.S. population (Curtis, Grier, & Hunley, 2004). The 2000 census data confirm this prediction. Latinos make up the largest non-European ethnic group (12.5%), and about 18% of the population speaks a language other than English. These demographic shifts are, perhaps, most evident in public schools. Racial-ethnic and linguistic diversity is more pronounced in the school-age population than in the general population. According to Planty et al. (2009), of the students enrolled in U.S. schools, 44% are racial minorities, 20% are linguistic minorities, and 16% are economically disadvantaged. Ethnic minority groups in the United States tend to have higher birth rates than does the general population, and recent immigrants to this country tend to be younger, with more school-age children, compared to the population overall. Such diversification in the school-age population affects the delivery of school psychology services as psychologists strive to meet the educational and mental health needs of all students.

The disproportionate representation of culturally and linguistically diverse (CLD) students in special education has been an recurring phenomenon in American education and, more recently, the focus of current legislation requiring states and school districts to evaluate their special education process and eliminate the "achievement gap" (Artiles, Trent, & Palmer, 2004). These public policy directives, combined with the significant rise in CLD students attending public schools, support the need for culturally responsive practices and competence among America's school psychologists. National organizations including the NASP and the APA provide a wide array of resources and documents related to cultural competency on their websites, conference topics, accreditation requirements, and through publications. Today, the resources published by these organizations no longer discuss the importance of acknowledging and accepting "differences." Rather, they now emphasize that school psychologists must modify and adapt their practices (e.g., assessment, intervention, consultation) to accommodate an individual's cultural and linguistic background (Ingraham, 2005).

Becoming culturally competent and engaging in culturally responsive practice is the focus of continuing professional development for many school psychologists. The foundation for cultural competence is the belief that all students have the potential to be successful in their academic endeavors when they are provided with quality programs, supports, and services within the school setting.

Klingner and her colleagues (2005) presented a conceptual framework and approach for addressing the disproportionate number of CLD students in special education with emphasis on the practices, policies, and people that affect the school environment. Klingner et al. believe that as more school-based practitioners, including psychologists, embrace culturally responsive practices, the more students will benefit. Culturally responsive practice moves beyond basic knowledge about and respect for diversity and cultural difference to an active responsiveness to differences in order to support students' success, including the re-structuring of instructional practices and implementation of unbiased assessment procedure (Klingner et al., 2005; Rogers et al., 1999; Weinstein, Tomlinson-Clarke, & Curran, 2004). According to the NASP (2010c) standards, school psychologists ensure that their knowledge, skills, and professional practices reflect understanding and respect for human diversity and advocate for effective services and social justice for all children, families, and schools. Culturally responsive practice specifically brings cultural issues to the forefront of service delivery and adjusts the assessment or intervention services to the language and/or cultural needs of children and families (Black, 2006). Both APA and NASP have created guidelines and position statements for specific knowledge and skills necessary to guide culturally responsive school psychology practice (APA, 1993; Ingraham, 2000; Rogers et al., 1999).

EXPANDED ROLES FOR SCHOOL PSYCHOLOGISTS

The roles of school psychologists and the focus of their service delivery efforts are continually expanding and changing to address growing challenges within the fields of education and psychology. In recent years, the academic, social-emotional, mental health, and medical needs of students and their families have increased in number, complexity, and severity (Crockett, 2004). School psychologists are being called on to assist schools in addressing these new challenges, often requiring them to take on expanded and new roles. This final section of the chapter describes four specialized areas in which involvement among school psychologists has increased, including systems change, pediatric psychology, working with families, and research and evaluation.

School Restructuring and Systems Change

As the needs of students continue to change, federal legislation has called for substantial revision in how schools provide educational and psychological services. There has been an increase in school reform efforts to focus on the implementation of RtI service delivery models, prevention and early intervention, EBP and data-based decision making (Curtis et al., 2008). Unfortunately, schools often experience significant difficulty when attempting to make sweeping school-wide changes. According to Curtis et al. (2008), effective system-wide change requires knowledge and skill regarding the specific change initiatives, as well as an understanding of organizational change and the application of problem-solving procedures. Because school psychologists receive training in each of these areas, they are often targeted for leading schools through systems-change efforts. Specifically, school psychologists have knowledge related to schools, organizational development and systems theory, as well as skills for collaborative planning and problem-solving (Curtis et al., 2008; Harrison & Prus, 2008). With this skill set, school psychologists are able to function as facilitators of school-wide change by (a) guiding the change process, and (b) guiding the implementation of innovative service delivery.

Guiding the Systems-Change Process

One way school psychologists facilitate change is by guiding schools through implementation of the systems-change process. Adelman and Taylor (1997) provide an effective framework for implementing system-level change that consists of four overlapping phases in which school psychologists may be involved. For example, in Phase 1, called "creating readiness for change," school psychologists assist with the formation and training of a core team of school personnel who are responsible for carrying out the change process. The team works to build consensus among all personnel regarding the need and vision for school-wide change. As part of the team, school psychologists may focus on disseminating information and providing professional development regarding reasons for change, desired goals or outcomes, the benefits, direct relevance for the school community, and possible incentives and costs of change, as well as policies for how change will occur and be supported (Ervin & Schaughency, 2008).

In Phase 2 of the change process, "initial implementation," school psychologists collaborate with stakeholders to determine the specific processes and strategies for implementing change, and they provide professional development to train and support personnel. This may include monitoring implementation and providing intensive coaching, consultation, mentorship, and technical assistance, as well as assisting with the development and use of formative assessments to gather feedback about the integrity, acceptability, and outcomes of the change process (Ervin & Schaughency, 2008). In Phase 3 of Adelman and Taylor's model, called "institutionalization," plans and procedures are developed and implemented to sustain system-wide change. Within this phase, the role of the school psychologist may be to assist school personnel in taking ownership of the change. For example, working plans are developed for providing ongoing professional development, maintaining adequate resources and support, addressing ongoing policies, and planning for challenges (Ervin & Schaughency). In the final phase, which is "ongoing evaluation," school psychologists play a major role in developing and implementing ongoing evaluation procedures and interpreting outcome data to guide ongoing problem solving around the changes and reforms (Curtis et al., 2008; Ervin & Schaughency, 2008; Godber, 2008).

Guiding Innovative School-Wide Service Delivery Practices

In addition to having the knowledge and skill to guide the process of change, school psychologists also have specialized knowledge of research evidence and best-practice guidelines related to the specific innovations and reforms schools have decided to implement. Ervin and Schaughency (2008) identified four common elements of system-wide innovations that have been shown to promote schools' capacity for meeting the diverse and growing needs of today's students. Consistent with the NASP training standards (2010c), school psychologists receive focused training and applied experience related to each element, including (a) multitiered, prevention-focused service delivery models, (b) evidence-based prevention and intervention practices, (c) alignment of school change with external (e.g., state or federal level) agendas, policies, and legal and financial frameworks, and (d) problem-solving consultation (Curtis et al., 2008). Because of their knowledge and skill related to each element, school psychologists are in a key position to assist schools with designing, implementing, and evaluating school-wide instructional or mental health service-delivery improvements.

Pediatric Psychology

A second expanded role for school psychologists is in the area of pediatric psychology. Pediatric psychologists work with children, families, and medical professionals to understand and treat the psychological challenges and associated physical, behavioral, and social-emotional problems that children with chronic illness face (Power, DuPaul, Shapiro, & Parrish, 1995). Examples of chronic illness commonly encountered by children and youth within school settings include diseases such as Type I diabetes, asthma, HIV/AIDS, and cancer, and developmental disorders and conditions such as fetal alcohol syndrome, attention deficit hyperactivity disorder, autism spectrum disorders, mental retardation, and child abuse and neglect (Brown, 2004). With advances in the medical field, along with developments and reform in health care and educational policies, children with these types of chronic health conditions are increasingly able to participate in general education and receive psychological services within schools. Therefore, school psychologists may expand their roles to address the needs and challenges of students with chronic medical conditions (Brown, 2004; Brown & DuPaul, 1999; Power et al., 1995).

To effectively meet the needs of students with chronic medical conditions, school psychologists often need to develop knowledge and skills outside the typical range of professional competencies. This includes developing an understanding of various medical conditions and the diverse effects they have on students' educational performance (Brown & DuPaul, 1999). For example, some diseases (e.g., cancer) and/or the treatments used for the management of the disease (e.g., chemotherapy) can affect a child's cognitive, learning, behavioral, and/or social-emotional functioning, which in turn can have detrimental affects on his/her performance in school (Brown, 2004; Brown & DuPaul, 1999). Specifically, children with chronic health concerns may experience cognitive impairment, deficits in visual/spatial perceptions and motor functioning, and/or challenges with maintaining attention, as well as the social stigma associated with an illness and/or its treatment and impaired peer relationships (Brown, 2004). School psychologists may need to expand their knowledge of appropriate assessment and intervention tools and practices that are effective in addressing these unique behavioral, social-emotional, and learning challenges (Brown & DuPaul).

With expanded knowledge and assessment and intervention skills, school psychologists are in a position to play a key role in advocating for the needs of students with chronic medical conditions in the school setting (e.g., identifying and accessing resources) and coordinating a team approach to developing a comprehensive, sensitive, and effective care plan. This includes monitoring and evaluating the effects of treatments and intervention plans (e.g., pharmacological effects on behavior) to guide problem solving and maximize outcomes (Power et al., 1995). Finally, because of their presence within school settings, school psychologists are in a unique position to expand their role to include the development and provision of universal health promotion and risk prevention programs (e.g., drug and alcohol abuse prevention) that include screening and early intervention services (Brown, 2004; Power et al., 1995).

Working With Families

Collaboration and consultation with families is an essential component of all students' education, not just for children with chronic medical conditions. Research consistently demonstrates that working with families and developing strong school-family partnerships results in improved outcomes not only for students, but for educators and parents as well (NASP, 2005). For example, effective school-family relationships have been shown to result in (a) improved student attitudes toward school and higher student academic achievement and homework completion, (b) improved morale and job satisfaction among educators and higher evaluation ratings from parents, as well as (c) enhanced self-efficacy among parents regarding their ability to academically support their children (Esler, Godber, & Christenson, 2008; NASP, 2005). In light of these positive effects, another expanded role for school psychology focuses on working directly with families, particularly families from diverse cultural and linguistic backgrounds. This expanded role may include, for example, facilitating collaboration and problem solving between families and teachers through conjoint behavioral consultation (Sheridan & Kratochwill, 2008) and educating families regarding school procedures, policies, children's rights, and available family and student resources (NASP, 2005). Additionally, school psychologists can use a family-centered service delivery approach to improve outcomes for all family members by promoting family strengths and building their capacity to self-identify needs and reach their goals (see Sheridan, Taylor, & Woods, 2008).

Although it is important for school psychologists to work effectively with individual families, it is also important that school communities work to develop strong school-family partnerships. Establishing strong school-family partnerships is a system-wide effort that often requires schools to implement new approaches to service delivery and to strive to create an overall climate that values and encourages school-family communication and collaboration (Esler et al., 2008; Miller & Kraft, 2008). Because of their skills related to systems-level change, school psychologists are also in a position to serve families by assisting schools to develop procedures that foster positive and effective school-family partnerships. Esler and colleagues (2008), for example, identify an effective change process that includes eight key practices for improving the capacity of schools to develop collaborative school-family partnership. These practices include establishing partnerships as a priority and making the development of partnerships a planned effort through the identification of student and family needs, resources and shared values. School psychologists can also assist schools in identifying and developing methods for proactive and consistent communication with families that is personalized, focuses on the child's needs as well as areas of strength, and offers practical and concrete suggestions for family support or involvement. Finally, school psychologists may assist schools in building strong relationships with families through systematic and ongoing evaluation of the school-family partnership process (Esler et al., 2008). Throughout this process, school psychologists have the opportunity to outline procedures for systematically sharing information with and involving parents in school-based problem solving and decision making (Miller & Kraft, 2008). School psychologists may also provide support and professional development to school personnel to increase their awareness of the importance and benefits of school-family collaboration, and to build their skills in working as partners with families from diverse cultural backgrounds and perspectives.

Research and Evaluation

Knowledge and skill in the areas of research and evaluation are foundational to the delivery of all educational and psychological services (NASP, 2010c). The success of the school psychology services identified in this chapter relies on the ability of practitioners to systematically analyze and evaluate their own practices. Schools are under increasing scrutiny to demonstrate results, show accountability, and ensure that all students are meeting learning outcome standards. Thus, program evaluation efforts to determine the effectiveness of school-based programs and to monitor success at increasing student achievement are becoming more common in schools and often fall to school psychologists to design and implement. School psychologists are frequently the professionals within schools targeted to conduct evaluations of programs and to generate evidence of effectiveness to present to key stakeholders, such as school board members, administrators, or the community (Braden, 2002).

As a profession, school psychology is closely aligned with research and evaluation. According to Farrell, Jimerson, Kalambouka, and Benoit (2005), however, relatively few school-based practitioners currently engage themselves directly in research activities or program evaluation. Even if engagement in formal research activities is not a primary role, school psychologists require a basic understanding of research to be effective practitioners. For example, school psychologists must be able to evaluate scientifically based intervention research to be able to identify, develop, and implement evidence-based practices (Stoiber & Kratochwill, 2000). Specifically, school psychologists play a major role in analyzing, synthesizing, and interpreting research for school personnel to identify practices with a substantial evidence base that fit the particular needs of the school, classroom, or individual child.

With the identification and implementation of EBP comes the need for scientifically based research and data collection to determine if the new practices are having the desired positive effect on student outcomes. Although many research topics are related to addressing student problems, there is a well-documented dearth of journal articles in the school psychology literature that evaluate school-based interventions, thus there is a compelling need for school psychologists to expand their roles as field-based researchers (Carper & Williams, 2004). Strein, Cramer, and Lawser (2003), for example, examined articles published in school psychology journals between 1994 and 1998; they also asked authors of articles and practitioners to rank order research topics. Whereas intervention studies were ranked the highest by both authors and practitioners, intervention research comprised only 3% of published articles. Conversely, assessment (ranked fifth), instrument development (ranked 11th), and evaluation (ranked 15th) accounted for more than 26% of the total articles in journals. Bliss, Skinner, Hautau, and Carroll (2008) conducted a similar analysis of the school psychology literature published between 2000 and 2005 and concluded there has been little increase in journal articles that evaluate the effects of interventions. Of the empirical studies, about half (50%) were correlational in nature and an additional 16% were descriptive. Less than 15% of the articles included any kind of empirical validation of interventions, with the majority employing minimally robust quasi-experimental research designs.

In sum, an important area for role expansion for school psychologists is research and evaluation. School psychologists' combined skills in research methodology, data analysis, and program evaluation enable them not only to translate scientifically based research findings into effective classroom practice, but also to make meaningful contributions to the literature on evidence-based practice (Keith, 2002).

CONCLUSION

Professional developments within the field of school psychology combined with recent federal legislation and school reform initiatives have contributed to the ongoing development and professionalization of school psychology. Scientific advances in evidence-based practice, data-based decision making, alternative assessment approaches, and problem-solving consultation, among others, have allowed school psychology to move away from embracing a predominantly test-based medical model of practice to incorporating a greater emphasis on prevention, intervention, and systems-level change. The result is that school psychology is now better positioned to promote academic success and contribute to positive educational, behavioral, and mental health outcomes for all children and youth in school settings.

REFERENCES

Adelman, H. S., & Taylor, L. (1997). Toward a scale-up model for replicating new approaches to schooling. *Journal of Educational and Psychological Consultation, 8*, 197–230.

Allington, R. L., & McGill-Franzen, A. (1992). Unintended effects of educational reform in New York. *Educational Policy, 6*, 397–414.

American Psychological Association. (1993). Guidelines for providers of psychological services to ethnic, linguistic and culturally diverse populations. *American Psychologist, 48*, 45–48.

American Psychological Association. (2002). Ethical principles. *American Psychologist, 57*, 1060–1075.

APA Presidential Task Force on Evidence-Based Practice. (2006). Evidence-based practice in psychology. *American Psychologist, 61*, 271–285.

Artiles, A. J., Trent, S. C., & Palmer, J. (2004). Culturally diverse students in special education: Legacies and prospects. In J. A. Banks & C. M. Banks (Eds.), *Handbook of research on multicultural education* (2nd ed., pp. 716–735). San Francisco, CA: Jossey-Bass.

Baker, D. (1988). The psychology of Lightner Witmer. *Professional School Psychology, 3*, 109–121.

Ball, C., Pierson, E., & McIntosh, D. E. (2011). The expanding role of school psychology. In M. A. Bray & T. J. Kehle (Eds.), *The Oxford handbook of school psychology* (pp. 47–60). New York, NY: Oxford University Press.

Barnett, D. W., Daly, E. J., Jones, K. M., & Lentz, F. A. (2004). Response to intervention: Empirically based special service decisions from single-case designs to increasing and decreasing intensity. *Journal of Special Education, 38*, 66–79.

Bergan, J. R., & Kratochwill, T. R. (1990). *Behavioral consultation and therapy*. New York, NY: Plenum Press.

Black, S. (2006). Respecting differences. *American School Board Journal, 193*(1), 34–36.

Bliss, S. L., Skinner, C. H., Hautau, B., & Carroll, E. E. (2008). Articles published in four school psychology journals from 2000 to 2005: An analysis of experimental/intervention research. *Psychology in the Schools, 45*, 483–498.

Braden, J. P. (2002). Best practices for school psychologists in educational accountability: High stakes testing and educational reform. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology*

IV (pp. 301–320). Bethesda, MD: National Association of School Psychologists.

Braden, J., DiMarino-Linnen, E., & Good, T. (2001). Schools, society and school psychologists: History and future directions. *Journal of School Psychology, 39*, 203–219.

Braden, J. P., & Shaw, S. R. (2009). Intervention validity of cognitive assessment: Knowns, unknowables, and unknowns. *Assessment for Effective Intervention, 34*, 106–115.

Bradley-Johnson, S., & Dean, V. J. (2000). Role change for school psychology: The challenge continues in the new millennium. *Psychology in the Schools, 37*, 1–5.

Bramlett, R. K., Murphy, J. J., Johnson, J., Wallingsford, L., & Hall, J. D. (2002). Contemporary practices in school psychology: A national survey of roles and referral problems. *Psychology in the Schools, 39*, 327–335.

Brown, R. T. (2004). *Handbook of pediatric psychology in school settings.* Mahwah, NJ: Erlbaum.

Brown, R. T., & DuPaul, G. J. (1999). Introduction to the mini-series: Promoting school success in children with chronic medical conditions. *School Psychology Review, 28*(2), 175–181.

Burns, M. K., & Coolong-Chaffin, M. (2006). Response to intervention: The role of and effect on school psychology. *School Psychology Forum, 1*, 3–15.

Caplan, G. (1970). *The theory and practice of mental health consultation.* New York, NY: Basic Books.

Carper, R. M., & Williams, R. L. (2004). Article publications, journal outlets, and article themes for current faculty in APA-accredited school psychology programs. *School Psychology Quarterly, 19*, 141–165.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge, UK: Cambridge University Press.

Cattell, R. B. (1941). Some theoretical issues in adult intelligence testing. *Psychological Bulletin, 38*, 592.

Chandler, L. K., & Dahlquist, C. M. (2009). *Functional assessment: Strategies to prevent and remediate challenging behavior in school settings* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Clay, R. A. (2010). APA updates its model licensure act. *Monitor on Psychology, 41*, 38.

Crockett, D. (2004). Critical issues children face in the 2000s. *School Psychology Review, 33*, 78–82.

Curtis, M. J., Castillo, J. M., & Cohen, R. M. (2008). Best practices in system-level change. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 887–901). Bethesda, MD: National Association of School Psychologists.

Curtis, M. J., Grier, J. E. C., & Hunley, S. A. (2004). The changing face of school psychology: Trends in data and projections for the future. *School Psychology Review, 33*, 44–69.

Cutts, N. (1955). *School psychologists at mid-century: A report of the Thayer conference on the functions, qualifications, and training of school psychologists*. Washington, DC: American Psychological Association.

Daly, E. J. III, Witt, J. C., Martens, B. K., & Dool, E. J. (1997). A model for conducting a functional analysis of academic performance problems. *School Psychology Review, 26*, 554–574.

D'Amato, R. C., Zafiris, C., McConnell, E., & Dean, R. S. (2011). The history of school psychology: Understanding the past to not repeat it. In M. A. Bray & T. J. Kehle (Eds.), *The Oxford handbook of school psychology* (pp. 9–46). New York, NY: Oxford University Press.

Daniel, M. H. (1997). Intelligence testing: Status and trends. *American Psychologist, 52*, 1038–1045.

Dawson, M., Cummings, J. A., Harrison, P. L., Short, R. J., Gorin, S., & Palomares, R. (2004). The 2002 multi-site conference on the future of school psychology: Next steps. *School Psychology Review, 33*, 115–125.

Dehn, M. J. (2006). *Essentials of processing assessment.* Hoboken, NJ: Wiley.

Deno, S. L. (2003). Developments in curriculum-based measurement. *The Journal of Special Education, 37*(3), 184–192.

Elliott, C. D. (2007). *Differential ability scales* (2nd ed.). San Antonio, TX: Harcourt.

Ervin, R. A., & Schaughency, E. (2008). Best practices in accessing the systems change literature. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 853–873). Bethesda, MD: National Association of School Psychologists.

Esler, A. N., Godber, Y., & Christenson, S. L. (2008). Best practices in supporting school-family partnerships. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 917–936). Bethesda, MD: National Association of School Psychologists.

Fagan, T. K. (1992). Compulsory schooling, child study, clinical psychology, and special education: Origins of school psychology. *American Psychologist, 47*, 236–243.

Fagan, T. K. (1994). A critical appraisal of the NASP's first 25 years. *School Psychology Review, 23*, 604–618.

Fagan, T. K. (1996). A history of Division 16 (School Psychology): Running twice as fast. In D. A. Dewsbury (Ed.), *Unification through division: Histories of the division of the American Psychological Association* (Vol. 1, pp. 101–135). Washington, DC: American Psychological Association.

Fagan, T. K. (2002). Trends in the history of school psychology in the United States. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology IV* (pp. 209–221). Bethesda, MD: National Association of School Psychologists.

Fagan, T. K., & Wise, P. S. (2007). *School psychology: Past, present, and future* (3rd ed.). New York, NY: Longman.

Farrell, P. (2010). School psychology: Learning lessons from history and moving forward. *School Psychology International, 31*, 581–598.

Farrell, P., Jimerson, S., Kalambouka, A., & Benoit, J. (2005). Teachers' perceptions of school psychologists in different countries. *School Psychology International, 26*, 525–544.

Feldman, E. S., & Kratochwill, T. R. (2003). Problem solving consultation in schools: Past, present and, future directions. *The Behavior Analyst Today, 4*(3), 266–271.

Fish, J. M. (Ed.). (2002). *Race and intelligence: Separating science from myth*. Mahwah, NJ: Erlbaum.

Flanagan, D. P., Ortiz, S. O., Alfonso, V. C., & Dynda, A. M. (2008). Best practices in cognitive assessment. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 633–660). Bethesda, MD: National Association of School Psychologists.

Fuchs, L. S. (2004). The past, present, and future of curriculum-based measurement research. *School Psychology Review, 33*, 188–192.

Fuchs, L. S., & Deno, S. L. (1991). Paradigmatic distinctions between instructionally relevant measurement models. *Exceptional Children, 57*, 488–500.

Fuchs, D., Mock, D., Morgan, P. L., & Young, C. L. (2003). Responsiveness to intervention: Definitions, evidence, and implications for the learning disabilities construct. *Learning Disabilities Research & Practice, 18*(3), 157–171.

Godber, Y. (2008). Best practices in program evaluation. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 2193–2205). Bethesda, MD: National Association of School Psychologists.

Gresham, F. M., Watson, T. S., & Skinner, C. H. (2001). Functional behavioral assessment: Principles, procedures and future directions. *School Psychology Review, 30*, 156–172.

Harrison, P. L., & Prus, J. S. (2008). Best practices in integrating best practices V content with NASP standards. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 71–99). Bethesda, MD: National Association of School Psychologists.

Hildreth, G. H. (1930). *Psychological service for school problems.* Yonkers-on-Hudson, NY: World Book.

Hintze, J. M., Christ, T. J., & Methe, S. A. (2006). Curriculum-based assessment. *Psychology in the Schools, 43*(1), 45–56.

Hoagwood, K., & Johnson, J. (2003). School psychology: A public health framework I: From evidence-based practices to evidence-based policies. *Journal of School Psychology, 41*, 3–21.

Horn, J. L. (1968). Organization of abilities and the development of intelligence. *Psychology Review, 75*, 242–259.

Hosp, M. K., Hosp, J. L., & Howell, K. W. (2006). *The ABCs of CBM: A practical guide to curriculum-based measurement*. New York, NY: Guilford Press.

Howe, M. (1998). *IQ in question: The truth about intelligence.* London, UK: Sage.

Ingraham, C. L. (2000). Consultation through a multicultural lens: Multicultural and cross-cultural consultation in schools. *School Psychology Review, 29*, 320–343.

Ingraham, C. L. (2005). Cross-cultural consultation. In S. W. Lee (Ed.), *Encyclopedia of school psychology* (pp. 139–143). Thousand Oaks, CA: Sage.

Jackson, J. H. (1990). School psychology after the 1980s: Envisioning a possible future. In T. B. Gutkin & C. R. Reynolds (Eds.), *The handbook of school psychology* (pp. 40–50). New York, NY: Wiley.

Jacob, S., & Hartshorne, T. (2007). *Ethics and law for school psychologists* (5th ed.). Brandon, VT: Clinical Psychology.

Jiminez, J. E., Siegel, L., O'Shanahan, I. O., & Ford, L. (2009). The relative roles of IQ and cognitive processes in reading disability. *Educational Psychology, 29*, 29–43.

Kaufman, A. S. (2000). Intelligence tests and school psychology: Predicting the future by studying the past. *Psychology in the Schools, 37*, 7–16.

Kaufman, A. S., & Kaufman, N. L. (2004). *Kaufman Assessment Battery for Children* (2nd ed.). Circle Pines, MN: American Guidance Service.

Kavale, K. A., & Flanagan, D. P. (2007). Ability-achievement discrepancy, response to intervention and assessment of cognitive abilities/processes in specific learning disability identification: Toward a contemporary operational definition. In S. R., Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.). *Handbook of response to intervention: The science and practice of assessment and intervention* (pp. 130–147). New York, NY: Springer.

Kehle, T. J., Clark, E., & Jenson, W. R. (1993). The development of testing as applied to school psychology. *Journal of School Psychology 31*, 143–161.

Keith, T. Z. (2002). Best practices in applied research. In A. Thomas & J. Grimes (Eds.). *Best practices in school psychology IV* (pp. 91–102). Bethesda, MD: National Association of School Psychologists.

Klingner, J. K., Artiles, A. J., Kozleski, E., Harry, B., Zion, S., Tate, W., . . . Riley, D. (2005). Addressing the disproportionate representation of culturally and linguistically diverse students in special education through culturally responsive educational systems. *Education Policy Analysis Archives*, *13*(38). http://epaa.asu.edu/ojs/article/view/143

Kratochwill, T. R. (2008). Best practices in school-based problem-solving consultation: Applications in prevention and intervention systems. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 1673–1686). Bethesda, MD: National Association of School Psychology.

Kratochwill, T. R., Albers, C. A., & Shernoff, E. S. (2004). School-based interventions, *Child and Adolescent Psychiatric Clinics of North America, 13*, 885–903.

Kratochwill, T. R., Gettinger, M., Reynolds, W. M., & Doll, E. J. (1988). School psychology at the University of Wisconsin–Madison. *Professional School Psychology, 3*, 93–107.

Kratochwill, T. R., & Shernoff, E. S. (2004). Evidence-based practice: Promoting evidence-based interventions in school psychology. *School Psychology Review, 33*(1), 34–48.

Kratochwill, T. R., & Stoiber, K. C. (2000). Empirically supported interventions and school psychology: Conceptual and practical issues: Part II. *School Psychology Quarterly, 15*, 233–253.

Kratochwill, T. R., & Stoiber, K. C. (2002). Evidence-based interventions in school psychology: Conceptual foundation of the procedural and coding manual of division 16 and the society for the study of school psychology task force. *School Psychology Quarterly, 17*, 341–389.

Kratochwill, T. R., Volpiansky, P., Clements, M., & Ball, C. (2007). Professional development in implementing and sustaining multitier prevention models: Implications for response to intervention, *School Psychology Review, 36*(4), 618–631

Lambert, N. M. (1993). Historical perspective on school psychology as a scientist-practitioner specialization in school psychology. *Journal of School Psychology, 31*, 163–193.

Martens, B. K., & Keller, H. R. (1987). Training school psychologists in the scientific tradition. *School Psychology Review, 16*, 329–337.

McGrew, K. S. (2005). The Cattell-Horn-Carroll theory of cognitive abilities: Past, present, and future. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 136–182). New York, NY: Guilford Press.

Merrell, K. W., Ervin, R. A., & Gimpel, G. A. (2006). *School psychology for the 21st century: Foundations and practices*. New York, NY: Guilford Press.

Miller, D. D., & Kraft, N. P. (2008). Best practices in communicating with and involving parents. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 937–951. Bethesda, MD: National Association of School Psychologists.

Minke, K. M., & Brown, D. T. (1996). Preparing psychologists to work with children: A comparison of curricula in child-clinical and school psychology programs. *Professional Psychology: Research and Practice, 27*, 631–634.

Nastasi, B. K., Varjas, K., Bernstein, R., & Pluymert, K. (1998). Mental health programming and the role of school psychologists. *School Psychology Review, 27*, 217–232.

National Association of School Psychologists. (2005). *Home-school collaboration: Establishing partnerships to enhance educational outcomes*). Bethesda, MD: Author.

National Association of School Psychologists. (2007). *Vision, mission, and goals.* Bethesda, MD: Author.

National Association of School Psychologists. (2010a). *Model for comprehensive and integrated school psychological services.* Bethesda, MD: Author.

National Association of School Psychologists. (2010b). *Principles for professional ethics.* Bethesda, MD: Author.

National Association of School Psychologists. (2010c). *Standards for graduate preparation of school psychologists.* Bethesda, MD: Author.

National Early Literacy Panel. (2009). *Developing early literacy: Report of the National Early Literacy Panel.* Washington, DC: National Institute for Literacy.

National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Washington, DC: U.S. Department of Health & Human Services, National Institute of Child Health & Human Development.

Oakland, T. D., & Jimerson, S. R. (2006). School psychology: A retrospective view and Influential conditions. In S. R. Jimerson, T. D. Oakland, & P. Farrell (Eds.). *The handbook of international school psychology* (pp. 453–462). Thousand Oaks, CA: Sage.

Osgood, R. L. (1984). Intelligence testing and the field of learning disabilities: A historical and critical perspective. *Journal of Learning Disabilities, 7*, 343–348.

Planty, M., Hussar, W., Snyder, T., Kena, G., KewalRamani, A., Kemp, J., ... Dinkes, R. (2009). *The condition of education 2009*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Pollack, R. H., & Brenner, M. W. (1969). *The experimental psychology of Alfred Binet: Selected papers*. New York, NY: Springer.

Power, T. J., DuPaul, G. J., Shapiro, E. S., & Parrish, J. M. (1995). Pediatric school psychology: The emergence of a subspecialty. *School Psychology Review, 24*(2), 244–257.

Pryzwansky, W. (1993). The regulation of school psychology: A historical perspective on certification, licensure, and accreditation. *Journal of School Psychology 31*, 219–235.

Rainey, V. C. (1950). *Training in clinical psychology*. Englewood Cliffs, NJ: Prentice-Hall.

Rees, C., Rees, P., & Farrell, P. (2006). Methods used by psychologists to assess pupils with motional and behavioral difficulties. *Educational Psychology in Practice, 19*, 203–214.

Reschly, D. J. (2000). The present and future status of school psychology in the United States. *School Psychology Review, 29*, 507–522.

Reschly, D. J., & Grimes, J. P. (2002). Best practices in intellectual assessment. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology IV* (pp. 1137–1150). Bethesda, MD: National Association of School Psychologists.

Restori, A. F., Gresham, F. M., & Cook, C. R. (2008). 'Old habits die hard:' Past and current issues pertaining to response-to-intervention. *California School Psychologist, 1*, 10–23.

Rogers, M. S., Ingraham, C. L., Bursztyn, A., Cajigas-Segredo, N., Esquivel, G., Hess, R., ... Lopez, E. C. (1999). Providing psychological services to racially, ethnically, culturally, and linguistically diverse individuals in the schools: Recommendations for practice. *School Psychology International Journal, 20*, 243–264.

Roid, G. (2003). *Stanford-Binet intelligence scales* (5th ed.). Itasca, IL: Riverside.

Rosenfield, S. A. (1987). *Instructional consultation*. Hillsdale, NJ: Erlbaum.

Shapiro, E. S. (2004). *Academic skills problems: Direct assessment and intervention* (3rd ed.). New York, NY: Guilford Press.

Shapiro, E. S., & Elliott, S. N. (1999). Curriculum-based assessment and other performance-based assessment strategies. In T. Gutkin & C. Reynolds (Eds.), *The handbook of school psychology* (3rd ed., pp. 383–408). New York, NY: Wiley.

Sheridan, S. M., & Gutkin, T. B. (2000). The ecology of school psychology: Examining and changing our paradigm for the 21st century. *School Psychology Review, 29*, 485–502.

Sheridan, S. M., & Kratochwill, T. R. (2008). *Conjoint behavioral consultation: Promoting family-school connections and interventions* (2nd ed.). New York, NY: Springer + Business Media.

Sheridan, S. M., Taylor, A. M., & Woods, K. E. (2008). Best practices for working with families: Instilling a family-centered approach. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 995–1008). Bethesda, MD: National Association of School Psychologists.

Short, R. J. (2002). School psychology as a separate profession: An unsupportable directive. *School Psychologist, 56*, 111–117.

Snyderman, M., & Rothman, S. (1990). *The IQ controversy, the media and public policy.* Piscataway, NJ: Transaction.

Stoiber, K. C., & Kratochwill, T. R. (2000). Empirically-supported interventions and schoolpsychology: Rationale and methodological issues-Part I. *School Psychology Quarterly, 15*(1), 75–105.

Strein, W., Cramer, K., & Lawser, M. (2003). School psychology research and scholarship. *School Psychology International, 24*, 421–436.

Stuebing, K. K., Fletcher, J. M., LeDourx, J. M., Lyon, G. R., Shaywitz, S. E., & Shaywitz, D. B. (2002). Validity of IQ-discrepancy classifications of reading disabilities. *American Educational Research Journal, 39*, 469–518.

Talley, R. C., Kubiszyn, T., Brassard, M., & Short, R. J. (Eds.). (1996). *Making psychologists in schools indispensable: Critical questions and emerging perspectives.* Washington, DC: American Psychological Association.

Torgeson, J. K. (2002). Empirical and theoretical support for direct diagnosis of learning disabilities by assessment of intrinsic processing weaknesses. In R. Bradley, L. Donaldson, & D. Hallahan (Eds.), *Identification of learning disabilities: Research to practice* (pp. 565–613). Mahwah, NJ: Erlbaum.

VanDerHeyden, A. M., & Burns, M. K. (2005). Using curriculum-based assessment and curriculum-based measurement to guide elementary mathematics instruction: Effects on individual and group accountability scores. *Assessment for Effective Intervention, 30*(3), 15–31.

Waller, R. J. (2008). *The teacher's concise guide to functional behavioral assessment*. Thousand Oaks, CA: Corwin Press.

Watkins, M. W., Crosby, E. G., & Pearson, J. L. (2001). Role of the school psychologist: Perceptions of school staff. *School Psychology International, 22*, 64–73.

Watson, T. S., & Steege, M. W. (2003). *Conducting school-based functional behavioral assessments: A practitioner's guide.* New York, NY: Guilford Press.

Wechsler, D. (2003). *Wechsler Intelligence Scale for Children* (4th ed.). San Antonio, TX: Psychological Corporation.

Weinstein, C. S., Tomlinson-Clarke, S., & Curran, M. (2004). Toward a conception of culturally responsive classroom management. *Journal of Teacher Education, 55*(1), 25–38.

Witsken, D., Stoeckel, A., & D'Amato, R. C. (2008). Leading educational change using a neuropsychological response-to-intervention approach: Linking our past, present, and future. *Psychology in the Schools, 45*, 781–798.

Wnek, A. C., Klein, G., & Bracken, B. A. (2009). Professional development issues for school psychologists: What's hot, what's not in the United States. *School Psychology International, 29*, 145–160.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson psychoeducational battery III*. Itasca, IL: Riverside.

Worrell, T. G., Skaggs, G. E., & Brown, M. B. (2006). School psychologists' job satisfaction: A 2-year perspective in the USA. *School Psychology International, 27*, 131–145.

Ysseldyke, J. E., Reynolds, M., & Weinberg, R. A. (1984). *School psychology: A blueprint for training and practice.* Bethesda, MD: National Association of School Psychologists.

Ysseldyke, J. E., Dawson, P., Lehr, C., Reschly, D., Reynolds, M., & Telzrow, C. (1997). *School psychology: A blueprint for training and practice II.* Bethesda, MD: National Association of School Psychologists.

Ysseldyke, J. E., Burns, M., Dawson, P., Kelley, B., Morrison, D., Ortiz, S., Rosenfield, S., & Telzrow, C. (2006). *School psychology: A blueprint for training and practice III.* Bethesda, MD: National Association of School Psychologists.

CHAPTER 16

Gifted Education Programs and Procedures

PAULA OLSZEWSKI-KUBILIUS AND DANA THOMSON

GIFTED EDUCATION PROGRAMS AND PROCEDURES

In this chapter, we review research related to the practices within the field of gifted education. Talent and giftedness is a phenomenon that greatly interests our society. However, educators have a somewhat ambivalent attitude toward giftedness and gifted children. There is no agreed-on definition of giftedness to guide practice and programs, as there is with other special categories of children; and there is no federal mandate to serve gifted children. As a result, the kinds of services available to gifted children in schools vary widely. We try to capture that variability and the issues that frame practice and theory within this emerging field of psychology and education. We also provide some perspectives on how this developing area of research and practice fits more broadly into the field of educational psychology and identify critical areas of future research and educational policy reform.

Conceptions of Giftedness

In this section, we review historical and current perspectives of giftedness and talent development with the goal of giving the reader a picture of the most pressing conceptual issues in the field. These perspectives on giftedness fall into several broad categories: those that emphasize culture and context, those that focus on achievement and performance, and those with a developmental focus. We also discuss several fundamental issues within the field that cut across these various perspectives.

The IQ Tradition

For many years, the field of gifted education was dominated by a conception of intellectual giftedness that emphasized individual differences in IQ. In practice, group and individual IQ tests are still often used to identify gifted children. The emphasis on IQ resulted largely from the work of Louis Terman, who in 1921 initiated a study of 1,500 children with IQ scores above 140 on the Stanford-Binet test. He and his colleagues studied these individuals longitudinally and prospectively, resulting in numerous publications about the Termites (Cox, 1926; Terman, 1925; Terman & Oden, 1947, 1957). The Termites were found to be well-adjusted, high-achieving adults. Few of them, however, attained eminence in their fields, and this single finding sparked a great deal of controversy about the role of IQ and more generally, intelligence alone, in defining giftedness and predicting adult accomplishments.

A Paradigm Shift

Beginning in the mid- to late 1980s, a paradigm shift occurred in the field of gifted education, from viewing giftedness as cognitive characteristics residing within the individual, largely determined by IQ or intelligence, to a focus on talent development as a phenomenon with a developmental trajectory that is complex, varies by domain or field, and is significantly influenced by environmental opportunities and psycho-social factors and characteristics. This shift received impetus from the work of Joe Renzulli (see later) whose theory of giftedness emphasized noncognitive factors such as task persistence and creativity, and from the seminal study of Benjamin Bloom (1985) who looked comprehensively at the roles of multiple contexts in the development of elite levels of talent in disparate domains such as art, science, and athletics. Outcomes of the Bloom study included that talent develops differently in different fields and specifically, the role and importance of various contexts such as the family, school, and community varies by field (e.g., community resources such as tennis coaches and music teachers). Bloom's study also revealed the developmental nature of talent development, particularly that as the child and talent matures and develops, different kinds of teachers are needed; for example, emerging talent requires teachers who generate motivation and interest, "adolescent" talent requires teachers who develop technique, and mature talent requires a teacher who helps a student develop his or her own voice or unique style. Bloom's study along with other perspectives on intelligence including those of Sternberg (1986) and Gardner (1983) provided the context for new perspectives about giftedness, reviewed below.

Perspectives on Giftedness and Talent That Emphasize the Role of Culture and Context

Several theorists emphasize the role of culture and context in defining giftedness. Tannenbaum (2003) proposed a typology of eight different types of gifted individuals recognized for their work in Western societies. Implicitly, then, giftedness is determined by what is culturally valued, which can change over time. The typology is created from the combination of two different types of gifted individuals: producers who can generate either thoughts or tangible products and performers who can generate either staged artistry or human services. Performers and producers can express their abilities at two different levels, either proficiently or creatively. For example, there are producers of thoughts creatively, such as poets, painters, and theoretical scientists, and there are producers of thoughts proficiently, such as computer programmers and editors. Similarly, there are producers of tangibles creatively, such as inventors and architects, and there are producers of tangibles proficiently, such as stonecutters or violinmakers. There are also performers of staged artistry whose work is mainly creative, such as orchestral conductors whose brilliance is in their interpretation of a composer's work, and performers of staged artistry whose talent is primarily in their proficiency, such as dancers who translate the choreographer's art into motion faithfully. Finally, there are performers of human services creatively, such as innovative teachers and political leaders, and there are performers of human services proficiently, such as physicians skilled at diagnosis and treatment and talented administrators of large corporations.

For Tannenbaum (2003), "developed" talent exists primarily, but not exclusively, in adults. Giftedness in children refers to their potential or promise to become critically acclaimed performers or exceptional producers. He proposes five factors that link childhood potential to adult productivity—general intelligence (such as high IQ or *g*), specific abilities, nonintellective factors such as personality and motivation, environmental factors such as support from the home, opportunities within the community or society's valuing of the talent area, and chance. All of these must be present to some minimum degree, although the importance of each can vary by field or domain, in order for childhood promise to develop into adult giftedness.

Csikszentmilhalyi proposes a sociocultural theory of giftedness. He says, "Talent cannot be observed except against the background of well-specified cultural expectations . . . . [Talent] is a relationship between culturally defined opportunities for action and personal skills or capacities to act" (p. 264) and "Talent is not the expression of a personal trait but the fulfillment of a cultural potential . . . " (p. 283, Csikszentmihalyi & Robinson, 1986). Csikszentmihalyi focuses on eminence and proposes that creativity is a result of an interaction of three components—an individual with expertise and problem-finding and problem-generation capabilities, a domain that consists of a body of knowledge and a symbol system (e.g., mathematics, music), and a field that consists of gatekeepers such as grant reviewers, critics, authors, and editors (Csikszentmihalyi, 1994). Creativity occurs when individuals produce new ideas that are evaluated by the field as worthy and interesting and are eventually incorporated into the domain's body of knowledge so as to be passed on to future generations. Csikszentmihalyi likens creativity to "cultural evolution." Individuals produce variations (new ideas) that are "selected" by the field and become the new norm within the domain (Abuhamdeh & Csikszentmihalyi, 2004).

Sternberg (2005) proposes a conception of giftedness that recognizes the role of culture and other contexts in determining intelligence and gifted behaviors. For Sternberg, it is the confluence of wisdom, intelligence, and creativity (WICS: Wisdom, Creativity, Intelligence Synthesized) that results in great leaders and contributors to society. Cultivating these abilities in children should be the goal of gifted education. A synthesis of wisdom, intelligence, and creativity is necessary for a person to achieve his or her highest potential. Intelligence is the basis for creativity and wisdom, but behavior is only deemed intelligent if it helps an individual to succeed in a particular context. Successful intelligence is a matter of applying one's analytical, creative, and practical abilities to shape or adapt to environments so as to accomplish personal goals *within a particular sociocultural context.*

Sternberg (2005) suggests that the processes of intelligence do not vary across contexts or cultures, but what is considered success certainly does. He believes that the manifestation of intelligence is very individual depending on a person's profile of abilities, what he or she wants to accomplish, and the contexts within which a person is living and working. Sternberg rejects traditional views of intelligence, particularly IQ and current intelligence tests, as too narrow and lacking in ecological validity. In this framework, creativity is not the purview of only the historic greats, but something anyone can use and as much an attitude and a decision as an ability. Creative thinkers "buy low and sell high" meaning that they generate ideas that are often initially rejected, convince others of the value of their ideas, and once others are sold on the idea, leave the elaboration to others and move on to a new idea. In Sternberg's view, being creative involves multiple skills and abilities, including the ability to simultaneously think outside the box as well as think practically and to be persuasive.

Finally, Sternberg (2005) asserts that wisdom is the most important attribute to develop in gifted individuals. Wisdom involves the application of both intelligence and creativity as mediated by values and a focus on the common good. Wisdom involves balancing self-interest with the interests of others. Although Sternberg does recognize the role of other factors in achievement such as motivation, he also says, "motivation is partly (although not exclusively) situational. With the proper environment, anyone can be motivated to achieve" (p. 340).

Perspectives on Giftedness That Emphasize Performance

Renzulli (2003, 2005; see also Renzulli & Reis, 1986) proposes a model of giftedness that de-emphasizes the role of ability—particularly general ability as measured by IQ—and instead stresses creative achievement. Renzulli prefers to speak of gifted behaviors and gifted performances rather than gifted individuals. Renzulli believes that IQ cutoff scores and ability or achievement scores typically used for the categorization of giftedness are arbitrary, exclusive, and represent a narrow view of intelligence.

For Renzulli, "Gifted behavior consists of thought and action resulting from an interaction among three basic clusters of human traits, above average general and/or specific abilities, high levels of task commitment, and high levels of creativity" (Renzulli, 2005, p. 267). Task persistence includes perseverance, self-confidence, the ability to identify significant problems, and high standards for one's work. Creativity includes openness to experience, curiosity, and sensitivity to detail. According to Renzulli, educational programs for children should concentrate on developing the personal characteristics and intellectual skills needed for adult creative productivity. School gifted programs should aim to produce the next generation of leaders, musicians, artists, and so on. In a more recent version of his theory, Renzulli recognized the important role of the interactions between personality and environment that result in the development of characteristics such as optimism, courage, sensitivity to human concerns, and sense of vision and destiny, which lead gifted individuals to focus their talents on solving social issues and bettering the human condition.

An extreme, performance-based perspective on giftedness and talent is that of Anders Ericsson (1996, 2001). Ericsson rejects the existence of an abstract construct called *giftedness* to explain high levels of achievement and instead focuses on the acquired nature of talent (2001). Ericsson believes that expertise in any area is a result of early exposure to the given domain and long years of instruction and practice. There is no such thing as "natural talent." Ericsson's research on elite performers in sports and athletics as well as music and chess has demonstrated the importance of what he calls deliberate practice, or practice that has clearly defined goals for improvement, requires intense concentration, and the ability to troubleshoot and refine performance based on feedback. Large differences in the hours spent in deliberate practices as well as in the early onset of practice (typically before age 5) consistently differentiate elite performers from amateur or less accomplished performers across various domains.

Deliberate practice is not necessarily enjoyable and the motivation to engage in it, which may be largely genetically determined, may be what most clearly distinguishes elite performers from less successful ones, with child prodigies being extreme examples of early and high levels of motivation (Ericsson, 1996). Ericsson proposes that it takes at least 10 years of intensive study and training for performers to reach peak performance or the top of their fields (Ericsson, 1996, 2001). Initially, coaches and teachers may be necessary for an individual to engage in deliberate practice, but over time, the individual will take over the responsibility for designing and structuring his or her deliberate practice activities.

Ericsson does not reject the idea of innate differences entirely. Differences in basic abilities, such as memory or speed, serve to predispose an individual to progress more rapidly toward expertise with intensive training. However, he proposes that intensive training results in many anatomical and physiological differences in elite athletes that have traditionally been attributed to innate differences (Ericsson, 1996, 2001). Deliberate practice may enable elite performers, for example, to overcome basic information processing limitations, such as short-term memory limits, because they learn to use long-term memory strategies more effectively. The effect of deliberate practice, as distinguished from repetition or play, is the acquisition of refined internal representations that the individual uses to improve his or her performance (Ericsson, 1996). Thus, deliberate practice ultimately improves performance because it affects internal cognitive structures.

Perspectives on Giftedness With a Developmental Focus

Gagne (2003, 2005, 2009) proposes a theory of giftedness with an emphasis on talent development. For Gagne, giftedness refers to exceptional natural abilities that, although not innate, appear primarily during the early years of children's development and demonstrate significant individual differences without any clear evidence of systematic learning, training, or practice. There are six domains of natural abilities: intellectual abilities, physical abilities (which include muscular and motor abilities), creativity, social abilities, and perceptual abilities. At the other end of the spectrum are talents, which "progressively emerge from the transformation of high aptitudes into the well-trained skills characteristic of a particular field of human activity" (Gagne, 2005, p. 102). Talents correspond to expertise within occupational fields.

Natural abilities provide the component operations that are used to acquire the skills and knowledge associated with expertise in a particular domain or field. Thus, natural abilities are the building blocks or constituent elements of systematically acquired talents, which means that one aptitude can be involved in the development of many different talents, and any talent can use abilities from more than one aptitude domain as its constituents (Gagne, 2003, 2005). For Gagne, gifted individuals are those who possess a natural ability in at least one of the six ability domains to a degree that places them in the top 10% of their age group. Similarly, talented individuals are those who possess levels of systematically developed abilities and skills that place them in the top 10% of individuals within the same field of endeavor.

According to Gagne's (2003, 2005) theory, one can be gifted and not talented; however, one cannot be talented and not gifted. Giftedness is childhood promise, whereas talent is adult fulfillment of promise. The process of talent development is then the systematic training and education sought by the gifted individual to develop talent to a high degree. That process is characterized by a long-term program of talent developing activities (e.g., lessons, programs) that lead to progress through a series of stages of increasing expertise. This trajectory is traversed at varying rates depending upon the individual's interest, motivation, and level of natural ability. Talent development also is influenced by critical experiences, turning points, and "catalysts," such as environmental supports and investment of time, money and resources on the part of the student, family and others (Gagne, 2009).

Subotnik (Subotnik & Jarvin, 2005) proposes a stage model for the development of talent that is based largely on retrospective studies of elite visual and performing artists and eminent scientists. Subotnik propose that abilities are necessary but not sufficient to reach the level of elite talent, which is defined as scholarly productivity or artistry. Subotnik emphasizes the role of personality and social factors in moving to higher and higher levels and domain-specific abilities, rather than general intelligence. Progress through the stages of talent development, which are ability, competence, expertise, and scholarly productivity or artistry, require not only growth in skills and underlying abilities, but other factors such as intrinsic motivation, ability to handle competition and criticism, understanding of one's strengths and weaknesses, ability to self-promote, self-confidence, and resilience. The relative importance of these characteristics changes from one stage to another. For example, teachability is critical for younger children while "biting back" and developing a unique style is important at later stages. Similarly, parental support is vital at the earliest stages, while mentors and expert teachers are essential at the stages of competence and expertise. Subotnik recommends that identification of children who can best profit from gifted programs should be done by artists and scholars, take into consideration both achievement and behavior at school as well as at home, and seek to select students who, based on personality and commitment, can be ready to maximize opportunities for talent development (Subotnik & Jarvin, 2005).

Summary

As can be seen from this brief summary of conceptions of giftedness, great variability surrounds many issues. Some conceptions emphasize demonstrated performance rather than high ability, such as Subotnik (in adult domains of activity) and Renzulli (in children), while Gagne emphasizes both but uses "giftedness" to refer to childhood potential and ability and "talent" to refer to adult achievements and accomplishment. Most other researchers and theorists use these terms interchangeably, as we do in this chapter. Several theories give equal weight to nonintellective factors such as motivation and personality dimensions as to cognitive ones (e.g., Renzulli, 2008; Subotnik &

Jarvin, 2005) or include them as important components in their model (e.g., Tannenbaum, Gagne). One theory takes an extreme position and gives primacy to factors other than ability in accounting for gifted levels of performance (Ericsson). Most models include creativity as an essential component of giftedness (e.g., Renzulli, 2008), or the final stage of giftedness after excellence or expertise (e.g., Csikszentmihalyi, 1994; Subotnik & Jarvin, 2005), whereas one theorist views it as a separate category and type of giftedness or natural ability (e.g., Gagne, 2009). Several theories emphasize the role of society and culture in defining and recognizing different types or categories of giftedness or talent (e.g., Tannenbaum, 2003; Gagne, 2009; Csikszentmihalyi, 1994), while Sternberg emphasizes context in determining intelligent behavior. Several conceptions view talent as a developing process (e.g., Gagne, 2009; Subotnik & Jarvin, 2005) with different kinds of external supports and personality characteristics necessary at different points or stages along the way, depending upon the talent domain.

These current conceptions of giftedness represent a significant shift in thinking about talent and its development and illustrate the importance of the following issues, which will likely continue to frame future discussion, research, and practice.

- There are different outcomes or endpoints of the talent development process, specifically eminence, creative productivity, or expertise, and these have implications for how children are identified and talent development programs are crafted.
- While there are general cognitive abilities that an individual uses regardless of field or domain, there are specific cognitive (e.g., spatial ability) and other types of abilities and characteristics (e.g., resilience, self-confidence, risk taking, charisma) that may be more relevant to success in particular fields or occupations.
- The relationship between creativity and intelligence is complex and important to understand if we want to promote adult creative productivity and elite levels of talent.
- Intelligence and creativity are both culturally and contextually defined and determined to a great extent.
- Giftedness is influenced by and developed within multiple contexts such as the family, school, community, and broader culture, and these can interact with each other in ways that are synergistic, compensatory, or antagonistic.
- Giftedness changes and develops over time and the paths for talent development vary by talent domain. Because of this, different kinds of supports, both educational and psychosocial, may need to be provided to students.
- Understanding the relationship between childhood giftedness and adult giftedness is critical to practice and policy within the field of education. Can you be a gifted child and not a gifted adult or vice versa?

There is no agreed upon definition of giftedness and talent. In fact, the field is challenged by the fact that there is a plethora of proposed definitions (Sternberg & Davidson, 2005). The National Association for Gifted Children (NAGC), the major advocacy organization for the field, recently revised its definition to be the following:

> "Gifted individuals are those who demonstrate outstanding levels of aptitude (defined as an exceptional ability to reason and learn) or competence (documented performance or achievement in top 10% or rarer) in one or more domains. Domains include any structured area of activity with its own symbol system (e.g., mathematics, music, language) and/or set of sensorimotor skills (e.g., painting, dance, sports)" (www.nagc.org).

This definition emphasizes the use of both aptitude and demonstrated achievement in academic and nonacademic domains.

Other Issues in Defining Giftedness and Talent

In this section we deal with several issues that have either polarized researchers within the field, such as the potential disparity between adult giftedness and childhood giftedness and the relationship between creativity and intellectual giftedness, or have greatly influenced the public perception of giftedness, such as child prodigies.

Adult Versus Childhood Giftedness

A major issue for the field is the relationship between childhood giftedness and potential and adult-level achievements. Many children with high ability do not achieve at expected levels in adulthood and many adults recognized for their achievements and accomplishments were not recognized as gifted as children. More recent models of giftedness, such as the one proposed by Subotnik and Jarvin (2005) attempt to address the potential paths from childhood potential to adult productive creativity and expertise through a focus on talent development.

Researchers who study gifted children are concerned with issues surrounding educational practice, such as the identification of gifted children and appropriate educational interventions or models. Within this tradition, emphasis is given to general intellectual ability, above-level academic achievement, precocity of achievements with respect to age peers, identification through testing, and schooling as the main context for talent development. In contrast, those who study adult giftedness focus on domain-specific abilities, the creativity of achievements or products and their contribution to the field, and an individual's standing or stature as judged by other experts in the field (Olszewski-Kubilius, 2000). A major difference between child and adult giftedness is the emphasis on the field. A measure of the quality of adult achievements is the critical acclaim they receive from other experts—the extent to which they break new ground or move the field forward. Gifted children do not typically create new knowledge; they discover what is already known—earlier and faster than most other children.

Few studies of children are prospective and longitudinal with the exception of the Terman studies; the Study of Mathematically Precocious Youth (SMPY), which has followed cohorts of verbally and mathematically talented students identified in their early teens in the late 1970s and early 1980s (Lubinski & Benbow, 2006); and the Fullerton Longitudinal Study (Gottfried, Gottfried, Bathurst, & Guerin, 1994), a study 107 individuals identified at age 1 in 1979. See Subotnik and Arnold (1994) for a more comprehensive listing of longitudinal studies. In contrast, there are many more retrospective studies of gifted adults. These studies look back into the lives of these individuals, usually through analysis of historical documents, biographies, and autobiographies and interviews if possible. Examples are V. Goertzel and Goertzel (1962), who studied the emotional and intellectual family environments of eminent individuals from the 20th century; Roe (1953), who studied 23 eminent male scientists in different fields; Zuckerman (1977), who studied Nobel Laureates; Subotnik, Karp, and Morgan (1989), who studied high IQ individuals who graduated from the Hunter College Elementary School from 1948 to 1960; and Bloom (1985), who studied high achievers in six different talent areas. Each of these research methodologies, retrospective and prospective, have yielded useful and interesting data about talent evolves over time, if only during certain developmental time periods. The SMPY study mentioned above has the potential to provide a comprehensive, life-span perspective on individuals talented in STEM, having just conducted a 40-year follow-up, with plans to continue to follow study participants indefinitely.

Child Prodigies

Prodigious achievement by children has always fascinated our culture and the general public often equates giftedness with child prodigies, which often fuels misunderstanding about these children. Feldman (2008) defines a child prodigy as, "a child who performs and is recognized for performing at an adult professional level in a valued, highly demanding domain" (p. 523). They are typically found in music, chess, and mathematics (Feldman, 2008), and less so in fields such as art and creative writing.

The prodigious achievement of a child is evidence of a rare coming-together of a variety of supportive conditions—a process that is termed *co-incidence* (Feldman, 2008; Morelock & Feldman, 2003). The supportive conditions include a domain or field that is structured in a way and developed to the extent that it is available, comprehensible, and attractive to a young child, a historical time in which the domain is valued and high-level mastery of it is prized, and a family that recognizes and supports the ability and can obtain resources to insure its development (Morelock & Feldman, 2003).

Although prodigies display exceptional capacity to master the levels of a particular field, their tremendously fast learning rate appears limited to a single domain. Prodigies are extreme specialists, according to Feldman, who may or may not stay with the same field into adulthood and even if they do, may not maintain their exceptional status (Feldman, 1986). According to Feldman, "the prodigy's early mastery of a domain may put him in a better position for achieving works of genius, for he has more time to explore, comprehend, and experiment within a field" (p. 16), but it is certainly no guarantee.

The Relationship Between Creativity and Intellectual Giftedness

Historically, the relationship between intelligence and creativity has been a much-debated issue. A significant part of the difficulty in ascertaining the nature of this relationship is the fact that there are no agreed upon definitions of either construct (see Sternberg & Davidson, 2005; Sternberg, Grigorenko, & Singer, 2004, for a discussion). According to Lubart (2003), previous attempts to understand the relationship between intelligence and creativity resulted in the widespread acceptance of the IQ threshold hypotheses—namely that there is a linear relationship between creativity, specifically divergent thinking, and IQ up to a certain level of intelligence and then there is no relationship. However, past research on which this conclusion was based is fraught with methodological issues such as biased compositions of extreme groups (see Lubart for a fuller discussion).

Most psychologists would agree that creative productivity is typically a complex adult phenomenon that is a multivariate in nature and includes intellectual skills. For example, Sternberg and Lubart (1995) assert that creativity involves the use of several different types of abilities and resources including intellectual skills of synthetic ability to define and represent problems in new ways, analytical skills to evaluate ideas and select the best ones, practical abilities to sell the value of the new idea to others, and divergent thinking abilities to generate many diverse ideas. Other resources include creativity relevant to personality dimensions such as risk taking, tolerance for ambiguity, and openness to new ideas, and motivation.

New, recent research suggests that measures of specific cognitive ability are, in fact, predictive of creative outcomes in adulthood, and contrary to the threshold hypothesis, this prediction is not truncated at a certain level of ability. Measures of mathematical reasoning ability at age 13 have been shown to predict adult achievement outcomes such earning a doctorate or tenure at a top university, as well as creative accomplishments such as publications and patents (Park, Lubinski, & Benbow, 2007, 2008; Wai, Lubinski, & Benbow, 2005). Additionally, patterns of performance on tests of mathematical and verbal ability or the “tilt” toward higher performance in one area compared to another, for example, mathematical versus verbal, predict whether these accomplishments will occur in the humanities versus science or mathematics (Park et al., 2007).

There have been many programs developed to advance the creative thinking skills of children and these dominated gifted education programming in the past. Examples include Odyssey of the Mind (OM), a creativity training program in which teams of children practice skills such as brainstorming, suspending judgment, and listening to others in order to solve complex, open-ended problems in a competition; and the Future Problem Solving program (FPS), which teaches students to use creative problem-solving techniques applied to ill-defined, complex problems about futuristic issues in competition with other teams of students (Meador, Fishkin, & Hoover, 1999).

Pyryt (1999) conducted a meta-analyses that examined the effects of various types of creativity training programs on aspects of children’s thinking. The studies included were from 1966 to 1994 and involved diverse populations of students such as learning disabled children, hearing impaired children, as well as intellectually gifted children. Pyryt reports that school aged children who received training in divergent thinking generally outperformed control subjects by nearly a standard deviation, when assessed on divergent thinking tests such as the Torrance Test of Creative Thinking. Furthermore more training produced larger gains in divergent thinking. A more recent review involving studies from 1999 to 2005 concluded that “training in creative thinking strategies can improve the abilities of students in the specific strategies in which they are trained” (Hunsaker, 2005, p. 296). However, more generalized effects have been difficult to document, although McCluskey, Baker, and McCluskey (2005) demonstrated that training in creative problem solving coupled with career exploration and mentoring, can used successfully to help at risk youths make better academic, vocational and personal decisions, including reducing recidivism rates among Native Canadian inmates.

A more important issue for researchers and educators is the predictive validity of so-called creativity measures in childhood for adult creative accomplishments. Cramond (1994), in a review of research on the Torrance Test of Creative Thinking and a study involving a 40-year follow-up on students identified as creative on the TTCT in childhood (Cramond, 2005), found moderate correlations between childhood tests of creativity and creative adult accomplishments. Participation in creative outside-of-school activities, both informal and formal, during childhood has been found to predict creative accomplishments in the performing arts in adulthood (Milgram, 2003).

Creativity training programs remain popular as a focus of gifted programming although many educators feel that these programs are appropriate for all children, not just gifted students. The current focus is on incorporating opportunities to be creative and develop and acquire creative thinking skills as part of an advanced curriculum within a content area rather than teaching them as a separate skill, e.g. giving students the opportunity to do independent projects on topics of great interest as a way of cultivating creative thinking (Renzulli & Reis, 1986).

THE EDUCATION OF GIFTED CHILDREN

Gifted education is primarily an applied field and theories and conceptions of giftedness undergird practices with these students in schools and in outside of school programs. Beliefs about how giftedness manifests itself fuel identification procedures. Perspectives about the relationship between intelligence and creativity and the importance of demonstrated achievement in defining giftedness are the basis for decisions about program design and student selection. In this next section, we review research regarding the identification of gifted students, instructional issues and practices, program types and designs, and the role of outside-of-school programs.

Identification of Giftedness and Talent

The identification of gifted children has and remains a major issue for the field and for practicing educators. It is fair to say that the field has focused a considerable amount of research on the issue of best methods of identifying gifted children, especially underrepresented and underserved subgroups of gifted children including low-income and minority children.

How gifted children are identified for programs and services is dependent on the beliefs and values of their school administrators regarding giftedness and the purposes of gifted education, and the characteristics of students to be served. For example, if you believe strongly that the aim of identification is to find children who have the potential to become creative producers in adulthood (see discussion of Renzulli earlier in this chapter), identification procedures might include a focus on demonstration of exceptionally creative work in school coupled with task persistence and motivation to produce unusual products at a high level. On the other hand, if you believe that giftedness is exceptional intellectual ability or potential regardless of actual achievement or performance, ability measures such as IQ scores could be used for identification, and you would aim to include children with high ability yet low school achievement and motivation.

Characteristics of students to be served also influence identification procedures. If the school or district has large numbers of high achieving students, tests that can assess achievement beyond grade level will be important in finding students who need curricula more advanced than the existing one. In contrast, if the school has large numbers of low achieving students, achievement tests may not be useful and use of local norms, ability tests, or performance assessment may be best to identify students who can learn at a faster pace and/or need an advanced curriculum.

A final but important consideration is the match between the identification procedures and the program. The content area (e.g., math versus language arts) and the degree of acceleration in the program (e.g., faster pacing within the class, presentation of advanced materials) all affect what kinds of measures and assessments are needed to determine that students are appropriately placed within the program.

Federal Definitions of Giftedness and Talent

Special educational services for gifted children are not required by law as they are for children with disabilities. The federal government's primary role has been providing definitions of gifted and talented children (Karnes & Marquart, 2000).

The most often cited definition of giftedness appeared in the U.S. Commissioner of Education's 1972 report to Congress. Sidney P. Marland, Jr., then U.S. Commissioner of Education, was directed in 1969 to undertake a study to determine the extent to which gifted students needed federal educational assistance programs to meet their educational needs. Referred to as the Marland Report, the definition he proposed for giftedness has been the mainstay of many local gifted programs.

Gifted and talented children are those identified by professionally qualified persons who, by virtue of outstanding abilities, are capable of high performance. These are children who require differentiated educational programs and/or services beyond those normally provided by the regular school program in order to realize their contribution to self and society. Children capable of high performance include those with demonstrated achievement and/or potential ability in any of the following six areas, singly or in combination: (1) general intellectual ability, (2) specific academic aptitude, (3) creative or productive thinking, (4) leadership ability, (5) visual and performing arts, (6) psychomotor ability. It can be assumed that utilization of these criteria for identification of the gifted and talented will encompass a minimum of 3 to 5%. (Marland, 1972, p. ix). Later, Category 6 was dropped from the definition.

A more recent definition was released by the U.S. Department of Education (1993) in a report entitled *National Excellence: A Case for Developing America's Talent.*

> Children and youth with outstanding talent perform, or show the potential for performing, at remarkably high levels of accomplishment when compared with others of their age, experience, or environment. These children and youth exhibit high-performance capability in intellectual, creative, and/or artistic areas, possess an unusual leadership capacity, or excel in specific academic fields. They require services or activities not ordinarily provided by the schools. Outstanding talents are present in all children and youth from all cultural groups, across all economic strata, and in all areas of human endeavor. (p. 3)

A national survey of state level policies and laws regarding gifted students revealed that 41 of 47 reporting states have definitions of giftedness in statute or regulations or both. However, only 29 of these states require local education agencies to follow them. The most common area or type of giftedness included in state definitions is intellectually or academically gifted (National Association for Gifted Children [NAGC], 2009). After that, creatively gifted, performing arts, and specific academic areas (e.g., math) are the next most frequently included. About 60% of reporting states indicated that they mandate specific criteria or methods to identify gifted students and almost all of these states require the use of multiple measures. Other frequently specified methods include the use of achievement data, IQ scores, or nomination.

Identification Practices

There is no current national level data available regarding actual practice of schools regarding identification measures and methods. Typically, standardized ability and achievement tests are still used, at least in part, but there have been some major changes in the ways researchers and practitioners within the field think about and approach identification, including:

- A movement away from conceptualizing identification as the process of selecting or determining who is gifted and who is not, and therefore who gets into programs and who does not, towards a movement that emphasizes domain-specific assessment aimed at determining students' level of existing knowledge about a subject or topic and/or learning abilities so as to provide a better match with pacing and level of instruction. This type of domain-specific assessment is evident in tests of mathematical reasoning ability, used as students approach middle school in order to help in future placement in enriched or accelerated classes.
- A tailoring of assessments to type of program or service, particularly when multiple types are available within large school districts. A single, large district may offer a full-time gifted program that pulls students from schools across the district and will use above-grade-level tests of achievement and ability to identify the highest performing or highest ability students. Simultaneously, schools within the district may use measures of math achievement to select students to be accelerated in middle school math. Scores on state level achievement tests may be used by individual schools for entrance into school-based enrichment programs.
- An interest in using nontraditional measures (e.g., performance-based assessments, portfolios, tests of nonverbal reasoning ability, and curriculum based assessments) particularly to identify students who are typically underrepresented in gifted programs (more on this issue below).

Identification of Underrepresented Students

A major issue and compelling, justifiable criticism of the field of gifted education is the underrepresentation of minority and low-income children within gifted programs and advanced classes (Borland, 2003). The underrepresentation of these students reflects larger societal inequities in educational access and opportunities in the U.S. and resultant disparities in achievement (Miller, 2004; Wyner, Bridgeland, & Diiulio, 2007). However, the underrepresentation within gifted programs is also attributed to problems with identification methods including lack of referral of students for gifted services by teachers who do not recognized the talents and abilities of minority or poor children and low test scores on identification instruments due to the cultural bias of standardized tests, especially for students for whom English is a second language. There is ongoing debate on whether standardized achievement and ability tests are culturally biased. This is because performance on such tests is consistently found to similarly predict school achievement for minority and nonminority students (Robinson, 2005). However, many educators within the field of gifted education recommend alternative methods of identification (Ford, 1996). These other methods include those mentioned above as well as training teachers to recognize typical indicators of verbal and mathematical talent and use of nonverbal ability tests with minority children or culturally and linguistically diverse students.

Nonverbal ability tests include the Naglieri Nonverbal Ability Test (NNAT), the Ravens Progressive Matrices, and others. Concerns about nonverbal ability tests center around their predictive validity for school achievement and thus usefulness to selecting students for advanced programs. Research suggests that they are poorer predictors compared to subject oriented achievement tests such as mathematics or reading, but when used in conjunction with scores on mathematics achievement tests, may be useful in selecting students with mathematical aptitude (Lohman, 2005).

Examples of performance-based assessments include DISCOVER (Sarouphim, 2002), which is a series of tasks designed to assess many of Gardner's multiple intelligences and involves teachers observing and recording students' problem solving while completing the tasks (e.g., completing puzzles), and Project Synergy, in which observations of children performing curriculum-based tasks, supplemented by test data were used to identify low-income minority kindergartners as potential candidates for gifted programs (Borland, Schnur, & Wright, 2000). VanTassel-Baska and colleagues (2008) developed a system of performance-based tasks to identify more gifted minority students that was adopted by the state of South Carolina. Her system was successful in increasing the number of both minority and nonminority children identified for gifted programs; however, the achievement of these students was lower compared to students selected for programs based on more traditional ability and achievement measures (VanTassel-Baska, Feng, & Evans, 2008).

Finally, there are those who propose continued use of the standardized ability and achievement tests in conjunction with customized and more appropriate norms and cutoffs for selection into gifted programs (Lohman, 2005; Lohman, Korb, & Lakin, 2008). Based on the belief that the goal of gifted education is to identify those students within a school who can learn at a faster rate or need curricula beyond what the school is offering, and recognizing that average levels of achievement vary from school to school (e.g., suburban school versus inner city school), a student's performance is compared to other students with similar demographic backgrounds and opportunities to learn. Those students whose achievement is better than other students in their school are identified as needing enriched and advanced curricula. This approach has the advantage of taking into account the circumstances of each particular school so that top students in poor, urban schools for example, are given opportunities to develop their talents and abilities even though their test scores are lower than those of more advantaged children in more advantaged school systems.

Instructional Issues

A great deal of attention has been given to identification practices within the field of gifted education and is reflected in a substantial body of research on the topic. However, identification is just the first step to serving these students within schools and the focus is primarily on giving them appropriate educational programming. Several major strategies are used with gifted students, all with the aim of providing a better match between their learning abilities and the pacing and content of instruction. Currently, the field of education is embracing differentiated instruction for all students, as a way of responding to the tremendous heterogeneity within any classroom and providing more tailored instruction to multiple levels of ability and achievement among students. Within the field of gifted education, differentiated instruction involves the use of acceleration, or adjustments in pacing of instruction, and enrichment, or the broadening or deepening of the curriculum. Grouping students with advanced abilities and achievement into separate classes or into clusters within classrooms is also a primary approach to providing gifted students the level and pacing of instruction that better matches their learning abilities. Additionally, a wide array of outside-of-school programs designed specifically for gifted learners has emerged, partly in response to the perceived lack of programming offered by schools and parental demand. These programs have become essential for many students, offering them their only opportunity for truly challenging study and peer contact.

Grouping Strategies

One of the major strategies for dealing with gifted students in school settings is ability grouping. Ability grouping broadly refers to a variety of options (e.g., full time or part time, more or less flexible, within-class or between-class) that place students into classrooms or small groups for the purpose of adapting instruction to differences in ability and learning rate. Full-time ability grouping options include special schools, a school-within-a-school (in which a semiautonomous education program for gifted students exists within a school), and full-time gifted programs or classes. Part-time options include performance grouping for specific instruction (in which students are placed in a classroom with others who are performing at the same level of difficulty in a specific subject area, such as mathematics or reading, but spend the rest of their day in a heterogeneous classroom), cross-grade grouping (which is similar to performance grouping for specific instruction but across grade lines), pull-out programs (in which select students are removed from their heterogeneous classrooms at set times for the purpose of providing enrichment opportunities which may or may not be connected to the regular school curriculum), cluster grouping (in which the top 5 to 8 students at a grade level are placed in an otherwise heterogeneous class so that they can become a "critical mass" for whom the teacher can find time to—and does—differentiate), and within-class grouping (in which individual teachers sort children in their own classroom according to their current performance in a specific subject area or unit).

The various grouping options have different benefits and disadvantages for students and teachers. Full-time options, such as special schools and school-within-a-school programs, give gifted students maximal exposure to intellectual peers and thus peer support for high achievement. It is also more likely that full-time programs, especially schools that specialize in a particular area (e.g., math and science, or the arts), have a greater capacity to offer students a rich and exceptional array of challenging courses and extracurricular activities from which to choose and instructors with gifted training and/or exceptional content area expertise. Most of these programs are highly selective, and competition to gain entrance is fierce. In addition, concerns have been voiced by some teachers and parents that students in full-time gifted programs may experience unhealthy levels of stress due to competition for grades and that students entering specialized schools may focus on a particular discipline too early without exploring other interests and options fully (Matthews & Kitchen, 2007; Sayler, 2006).

Programs that group students by ability for subject-specific instruction (whether within-class, between-class, or across grade lines) have the benefit of being able to accommodate gifted students with "tilted profiles" (i.e., students who demonstrate exceptional ability in one or two subject areas, but merely average or above average ability in other areas). Grouping for specific instruction can thus provide a particularly good match between a student's subject-area ability and placement, as well as opportunities to engage with peers who share their interests and ability in that area. However, these programs can be difficult for administrators because of the complexity of scheduling, which for between-class or cross-grade grouping, often requires grade-wide or school-wide coordination (Rogers, 2002). Within-class grouping is typically easier to schedule, but can present a challenge to teachers who may feel pulled in multiple directions by having to cater to different groups. And often general classroom teachers do not have the time or training needed to provide a truly differentiated curriculum to the different groups of students (Archambault et al., 1993). Cluster-grouping attempts to address this difficulty by placing a critical mass of gifted students (5 to 8) in one classroom with a teacher who has been trained to differentiate learning experiences for this group, and can also justify spending the time to do so (Gentry & Owen, 1999).

Part-time options such as pull-out programs (also known as *resource room* programs) similarly have the advantage of giving students contact with both age-mates and intellectual peers in a single day. Pull-out programs also offer students an opportunity to work with a teacher who has typically had some gifted training and is aware of some of the unique needs of gifted students. However, being pulled out of the regular classroom for a program makes the gifted students conspicuous, which they may not like. Moreover, teachers and administrators often struggle to define and coordinate the curriculum for these programs and sometimes students are required to make up the work that they missed while out of the regular classroom. Additionally, most pull-out programs involve only 1 to 2 hours of instruction per week and so are quite minimal in scope and impact (Rogers, 2002).

Issues Surrounding Ability Grouping

The use of ability grouping within schools tends to vary according to the broader political climate of the time (see Kulik, 1992). In the 1960s, ability grouping was employed widely and hailed as successful; but beginning in the early 1990s, it came to be viewed negatively as another form of tracking and schools expressed concerns about the effect of ability grouping on overall student achievement, teachers' expectations of students, instructional quality, racial and social discrimination, and mobility and social cohesion (Rogers, 1991). The concerns have to do primarily with whether ability grouping negatively affects students who are not in the highest group, specifically whether it lowers their achievement or motivation. The concern centers on whether there is a general lowering of the intellectual level of the classroom when very bright students are removed or lowered teacher expectations or poorer instruction. Additionally, concerns have been voiced about whether placement with other bright students lowers individual gifted students' self-esteem, stresses them with unrealistic performance demands, or affects their sociability with average-ability peers (Marsh, Chessor, Craven, & Roche, 1995; Marsh & Hau, 2003; Neihart, 2007).

Kulik (1992) and Rogers (1991, 2007) agree that the effects of ability grouping vary greatly depending upon the type of program or curriculum that is given to the different groups of learners. Kulik's (1992) meta-analysis of studies in which students were ability grouped but given the same curriculum shows that students in the lower and middle groups learn the same amount as do students of the same ability levels who were placed in heterogeneous classes. Students in the high group learn slightly more than do students of the same ability placed in heterogeneous classes—1.1 compared to 1.0 years on a grade-equivalent scale after a year of instruction. The results of meta-analyses of these types of grouping arrangements have often been used as evidence of the ineffectiveness of ability grouping by educators. However, Kulik argues that these studies do not properly address the issue of ability grouping because no real differentiation of curriculum took place.

By contrast, the results of meta-analyses of programs that involved within- or across-grade ability groupings of children *who received different curricula* showed some increased learning for *all* groups (Kulik, 1992). Typically, students who were ability grouped gained 1.2 to 1.3 years on grade equivalent scale compared to 1.0 years for students of comparable abilities in mixed-ability classes. Kulik concluded that the effects of grouping are strongest for gifted students because the adjustment of the content, curriculum, and instructional rate is more substantial. Specifically, Rogers' (2007) synthesis of the research on various grouping practices reported positive effects for gifted students ranging from one third of a year's additional growth for full-time gifted classes at the secondary level, performance grouping for specific instruction, and within-class grouping, to almost a half of a year additional growth for cross-graded classes and full-time gifted classes at the elementary level, to three fifths of an additional year's growth for cluster grouping.

The evidence regarding the effects of ability grouping on self-esteem and other self-perceptions is mixed. Delcourt, Cornell and Goldberg (2007) found no differences between gifted students in various grouping arrangements, including pull-out programs, within class clustering programs, separate class programs, or special school programs in terms of their perceptions of their social acceptance. However, these authors did find that students who were in special gifted classes for instruction in specific content areas had the lowest perceptions of their academic ability compared to students in other grouping arrangements or comparison groups of high achieving students who were not grouped for instruction. Marsh and colleagues (Marsh et al., 1995; Marsh & Hau, 2003) refer to this as the "Big Fish, Little Pond" (BFLP) phenomenon and have found cross-cultural evidence that students who attend selective school and accelerated programs may experience declines in their perceptions about their academic abilities as a result of comparing themselves to other talented students in that setting. The question remains, however, whether getting a more realistic appraisal of one's abilities is helpful or harmful in the long run.

In summary, while ability grouping without any curricular modification produces little or no differences in student achievement, both gifted and nongifted students benefit from being grouped with like-ability students when the curriculum is adjusted to the aptitude levels of the group. Moreover, ability grouping had positive effects for gifted students whether it was full time or part time. The major benefits for each grouping strategy for gifted students are its provision of the format for enriching or accelerating the curriculum they are offered (C. Kulik & J. Kulik, 1992) and the opportunity to socialize and learn with peers who have similar interests and abilities (Rogers, 2007).

Differentiating Learning Through Enrichment and Acceleration

As discussed above, grouping strategies are usually implemented for the purposes of providing an enriched and/or accelerated learning for academically able students. Acceleration and enrichment are the cornerstones of gifted education. Definitions of enrichment vary, but it is typically considered to be instruction or content that extends learning beyond the boundaries of the curriculum. Practitioners attempt to provide enrichment to gifted students in a variety of ways—increasing the breadth of the curriculum by adding content that is not typically covered and perhaps is more abstract; adding depth by allowing students to study a topic more deeply and more thoroughly; adding opportunities for more real-world applications of the content learned through projects and research; or focusing on higher-order learning skills such as divergent thinking or problem-solving skills. The goal of enrichment for gifted students is to challenge and offer opportunities for growth in the area of the student's giftedness and/or to help the student develop more complex cognitive skills, including critical and creative thinking (Schiever & Maker, 2003). In contrast to acceleration, enrichment tries to meet the educational needs of gifted students by the addition of content rather than adjustments to pacing of instruction (Southern, Jones, & Stanley, 1993).

Typically, acceleration is thought of as grade skipping, but it actually encompasses a large number of practices. Acceleration is defined as "progress through an educational program at rates faster or ages younger than conventional" (Pressy, 1949, p. 2, as quoted in Southern et al., 1993, p. 387). Southern and Jones (2004) list 18 distinct accelerative practices. Full-time options include early admission to any level of schooling (most commonly, kindergarten, first grade, or college), grade-skipping, and early graduation. Part-time options include subject-based acceleration (in which students are placed in an advanced-level class for a specific content area), continuous progress or self-paced instruction (student is allowed to progress as prior content is completed and mastered), combined classes (multigrade classrooms that provide opportunity for students to interact with older peers and work as needed at higher grade level), curriculum compacting or telescoping (the strategy of allowing students to bypass curriculum they have already mastered or progress through the curriculum more rapidly than usual), mentoring, extracurricular programs, distance learning or online courses, credit by examination (student is awarded advanced standing or credit by successfully complete some form of mastery test or activity), advanced placement, and concurrent or dual enrollment in two levels of schooling simultaneously (see Southern & Jones, 2004, for a thorough description and analysis of accelerative practices and options).

As with grouping strategies, each accelerative strategy has its advantages and disadvantages. In general, acceleration benefits gifted students by providing a closer match between level of instruction and level of achievement, as well as a reduction of boredom and increased motivation due to a more appropriate level of challenge, both of which engender the acquisition of good study habits and avoidance of underachievement. In addition, both full- and part-time accelerative options may allow students more time to explore multiple majors and/or areas of interest (Southern et al., 1993). However, while most full-time accelerative options bring content reserved for older students down to younger ones, few are designed to address gifted students' capacity to acquire new material at a rate faster than that of other students or the different ways in which a student may be gifted — though some part-time options, such as curriculum compacting and continuous progress, may serve this need (Southern & Jones, 2004). Teachers need the requisite skills and time to compact or telescope curriculum; and self-paced content acceleration for individual students requires planning time and special management techniques (Shiever & Maker, 2003).

Issues Surrounding Acceleration and Enrichment

Despite its many forms, schools infrequently use accelerative strategies, and many educators have negative attitudes about them based on single experiences with individuals who were grade skipped (Southern et al., 1993). Opponents of acceleration give the following as negative consequences of acceleration: academic problems stemming from gaps in content preparation; what has been called a specious precocity due to knowledge without appropriate experience; an undue focus on learning the right answers and short shrift to creativity and divergent production; social adjustment problems as a result of a reduction of time for age-appropriate activities; rejection by older classmates; less opportunity to acquire social skills via interaction with same-aged peers; reduced extracurricular opportunities such as participation in sports or athletics due to age ineligibility; and emotional adjustment problems due to stress and pressure to perform (Neihart, 2007; Southern et al., 1993).

The research evidence regarding the efficacy of acceleration for gifted students is the same research cited previously for grouping (e.g., Kulik, 1992; C. Kulik & Kulik, 1992; Rogers, 1991, 2002; Rogers & Span, 1993) and is overwhelmingly positive. Accelerated students of both elementary and secondary levels performed as well as older nonaccelerated students of comparable ability or outperformed same-aged, nonaccelerated peers on standardized achievement tests by nearly one year. Rogers' (2007) analysis by type of accelerated strategy showed that there were substantial academic gains for the following options: grade-skipping, subject acceleration, credit by examination, mentorships, nongraded or multiage classrooms, curriculum compacting, and grade telescoping (completing 2 years of school in one). Also, research has generally shown that acceleration, particularly grade skipping and early admission to school/college, did not result in social and emotional difficulties including difficulties making friends with older students (Colangelo, Assouline, & Gross, 2004; Neihart, 2007; Rogers, 2002).

Academic gains of 4 to 5 months (on a grade-equivalent scale) were also found for gifted students grouped into enrichment classes compared to equally able students in regular mixed-ability classes (Kulik, 1992). Rogers (1991), in a review of research on ability grouping, concluded that there were also positive gains for gifted students who were receiving enrichment in cluster groups within their classes or in pull-out programs on measures of critical thinking, general achievement, and creativity.

Acceleration and enrichment have often been pitted against each other as opposing educational strategies. In reality, the distinctions between them are often very blurred. Providing additional content via enrichment often results in a student's being ahead of or accelerated with respect to other students in achievement. Often the additional content provided is content reserved for older students. Programs that truly meet the needs of gifted students will be some combination of enrichment and acceleration — adjustments to content as well as adjustments to instructional pace. The preference for acceleration or enrichment as an educational strategy to serve gifted children often has to do with societal sentiments and political ideologies prevailing at the time (Southern et al., 1993).

Differences Between Gifted Programs Used at the Elementary and Secondary Levels

A recent national survey of state level policies and laws regarding gifted students revealed that in early and upper elementary and in middle school, the three most common methods are within-class accommodations, followed by pull-out programs and cluster grouping. At the high school level, both Advanced Placement (AP) and dual enrollment in college were more common than within-class accommodations (NAGC, 2009).

Within the field of gifted education, the lion's share of the research and writing about programs is focused on elementary school-aged children. For children in this age range, both program models (e.g., Renzulli's model, multiple intelligences) and different kinds of administrative and grouping arrangements for the delivery of services (e.g., pull-out programs, enrichment, cluster grouping, acceleration, curriculum compacting) abound. However, for secondary-level students, fewer models for programs exist, and creative service delivery options are rarely employed. In most secondary schools, honors-track and AP classes are the only options for students functioning above grade level. However, at the secondary level (in contrast to the elementary level) accelerative options are more readily accepted as a means to accommodate gifted learners owing in part to the success and wide acceptance of the AP program, which implies that students are working at least 1 year above grade level.

At the elementary level, there is often an individual responsible for the gifted program—the gifted coordinator. At the secondary level, this is rarely the case. Special classes for advanced secondary students typically occur within departments that are organized around major content domains. This means that many opportunities may be available to students to develop high levels of talent within particular domains. It can also result in a program that has many good parts but no whole—no systematic means or process of identifying students who need special programming and no integration across the curriculum (VanTassel-Baska, 1998).

Qualities of Effective Gifted Programs

Decisions regarding gifted programming are complex. They often involve looking not only at research about program effectiveness, but also at the specific needs and abilities of the individual gifted students who are to be served by a program or combination of programs, as well as the broader context of the whole school and the community in which it is located. Successful programs for all gifted students, and especially underserved gifted children, must be multi-faceted and flexible (Olszewski-Kubilius & Thomson, 2010). Interventions need to recognize, affirm, acknowledge, and take advantage of strengths, and identify, understand, and compensate for weaknesses in schools, families, and communities. Moreover, effective programs build support within the family, the school and the community and are tailored to the needs of individual children and families.

Nonetheless, Rogers (2002) lists a number of guidelines for in-school provisions that can be gleaned from the research. First, she states that grouping is important: specifically, that teachers and parents must find ways to allow gifted students to spend the *majority* of their learning time in the academic core areas with others of like abilities and interests. She also notes that within-class grouping is usually not sufficient. Further, she stresses that regardless of which grouping strategy is chosen, attention must be focused on what will be taught, at what pace, and to what level of depth. An appropriately differentiated curriculum is essential, and both enrichment and acceleration are complementary components of a comprehensive curriculum for gifted learners.

Outside of School Programs and Opportunities

After decades of research, we now know that the development of talent is a complex, multifaceted process that takes place over a long period of time, in multiple contexts (e.g., family, school, community), both formal (e.g., school) and informal (e.g., museums, homes) in nature. Research has shown that for some talent domains, outside-of-school programs may be more important in terms of talent development than inside-of-school programs (Bloom, 1985). Also, the creative and challenging activities that students pursue outside-of-school have been found to be predictive of their eventual career in adulthood (Milgram, 2003). For example, practicing scientists and graduate students in science report that informal learning outside-of-school, such as doing science experiments at home, had the effect of significantly building and engendering interest in science careers as early as the middle school years (Maltese & Tai, 2010). For some gifted students, particularly low-income students, summer opportunities may be essential to continued high achievement and development of their talents. Based on research conducted by the National Center for Summer Learning, lower income children lose as much as 3 months of progress in math and reading and these shortfalls accumulate throughout the elementary years of schooling to account for about two-thirds of the difference in the likelihood that they will pursue a college prep curriculum in high school (www.summerlearning.org).

Outside-of-school programs have many other benefits including: giving gifted students access and contact with true peers; providing students with appropriate benchmarking with respect to the development of knowledge and skills in the talent area in comparison to other talented students and in comparison to adult professional standards; giving students alternative ways to take additional advanced courses and accelerate; providing students with tacit knowledge about higher education and career paths within the talent areas, garnered from adult professionals; enabling students to experience authentic work in the talent area, which is highly motivating; assisting students in acquiring the personal skills needed for success in the field including the ability to receive and respond positively to feedback and criticism and deal with competition and setbacks; building motivation for high achievement due to providing a better match to student's interests and learning styles and a supportive peer network; providing opportunities for students who lack appropriate supports from their families or schools to acquire skills and knowledge that will qualify them for gifted programs and services in school; preventing skill loss in the summer, especially for children from low-income families, that can accumulate over years of schooling and eventually affect preparedness for college (www.summerlearning.org; Olszewski-Kubilius, 2010).

In 29 states within the United States, legislation enables high school students to be simultaneously enrolled in high school and college—referred to as *dual enrollment, concurrent enrollment,* or *postsecondary option* (NAGC, 2009). Students who partake of this outside-of-school option spend part of their day on a college campus taking a college course or take the course from a college instructor within their home school. The legislation across states varies considerably (McCarthy, 1999; NAGC, 2009; Olszewski-Kubilius & Limburg-Weber, 1999) but typically requires high schools to use their per-pupil state funds to pay part or all of the college tuition. The legislation may stipulate what kinds of courses can be taken (typically only courses that the high school does not offer), the number of courses that can be taken, and the types of institutions (private versus public) that students can attend. Some states specify the circumstances under which students can earn high school and college credit and the amount of credit that can be earned. Most states reserve dual enrollment for juniors and seniors who have already earned a certain number of high school credits or satisfied a specified number of graduation requirements, although 17 states allow dual enrollment for students younger than grade 11 (NAGC). Dual enrollment is a way for gifted students to get advanced courses that their high schools do not early and earn college credits. The downside of this kind of program is that is places students on a college campus and with older students, so it is most appropriate for students who are mature enough to handle the social situation.

Other outside-of-school programmatic options for gifted secondary students include competitions and internships. These options are not exclusively for gifted students, although they typically require demonstration of a high level of interest in a specific area (internships or competitions) or require advanced skills in order to be qualified (competitions) (Olszewski-Kubilius, 2010). Thus, they are often viewed as most appropriate for students who are gifted. Competitions are typically extracurricular activities, and students can participate via the sponsorship of their school or on their own. There are many different kinds of competitions (Karnes & Riley, 2005) in many different domains. The benefits of competitions include learning how to compete, acquiring and honing independent study skills, gaining opportunities for feedback and critique from professionals, getting tacit knowledge about educational and career paths from adult professionals, and opportunities to work on real-world problems. Competitions also often have significant cash prizes. Several of the best known are the Intel Science Talent Search and the Mathematics, Physics, and Chemistry Olympiads. Usually, students who get involved in team competitions prepare for them via a high school club. These extracurricular activities have many advantages for students; they provide socially supportive contexts within which students can learn a great deal of specific subject matter (Subotnik, Miserandino, & Olszewski-Kubilius, 1997).

Internships are typically available to college-aged students, although increasingly, these opportunities are being opened to high school students and being organized by high schools. The benefits of internships are primarily in the opportunities to participate in significant adult work and to connect with professionals who can assist with career and educational planning (Olszewski-Kubilius, 2010; Olszewski-Kubilius & Limburg-Weber, 1999).

Other options for gifted students include special schools. Currently there are 14 special residential high schools within the United States (NAGC, 2009) designed for students who are talented in math or science. These schools are mandated by state legislatures and supported by state education dollars, which means they are free or have minimal fees. Most serve students in grades 11 and 12 only, while a few start at grade 10. They offer an advanced curriculum in mathematics and science, one that is both broader and deeper than would be found at a typical high school (Thomas & Williams, 2010). They can also give students educational opportunities that are not usually available to most high school students, such as working with scientists on research, access to state-of-the-art laboratories, mentoring, and career counseling (Olszewski-Kubilius & Limburg-Weber, 1999). These schools are also home to some internationally ranked chess, debate, and academic teams (Thomas & Williams, 2010). In addition, there are other public and private specialized high schools. The National Consortium of Specialized Secondary Schools in Science, Mathematics, and Technology has more than 100 institutional members from across the United States (Thomas & Williams, 2010).

Another option for gifted high school students is early entrance to college. Many students across the United States leave high school one year early and enter college; most colleges and universities readily accept younger students. However, a dozen or so special early college entrance programs exist that accept students 2 to 4 years early (Muratori, 2007). These programs are often designed so that students simultaneously complete high school graduation requirements and earn college credits. Some are supported by state education dollars. These programs provide special support systems for students in the form of designated counselors, separate dormitories, and social events (Muratori, 2007). Research has shown that, when carefully selected, through interviews and multiple criteria, early entrants succeed academically and comparably to typically aged, high scoring college students (Olszewski-Kubilius, 1995). If they do leave college, it is often for the same reasons as typically aged college students (Muratori, 2007; Olszewski-Kubilius, 1995; Olszewski-Kubilius, 1998a).

Summer programs for gifted students have increased tremendously in the past two decades, and there are hundreds of such programs in the United States for advanced and gifted learners (Berger, 2008). These vary in length and type (accelerative versus enrichment-oriented) and most take place on college campuses. Distance learning programs are also growing—for example, there are 16 states with state-supported virtual high schools (NAGC, 2009) and hundreds of other online learning programs (Kiernan, 2005) across the country. Some distance learning programs offer a complete high school curriculum. Although most distance education programs for high school students are focused on credit-recovery, several programs are geared specifically toward advanced learners and offer AP courses or college-level courses through the Internet, utilizing web technologies to enable students to meet online virtually and to interact with other students online (Olszewski-Kubilius & Lee, 2008). Gifted students use distance-learning courses to take advanced courses that they cannot fit into their schedule at high school or to take courses not offered by their school (Olszewski-Kubilius & Lee, 2004). This is an area of research that is in its infancy, but one of the benefits of online courses for gifted students, perceived both by students and teachers is the individualization and personalization that is possible. Students and teachers also perceived that the flexibility of the online learning environment was conducive to students working at a pace consistent with their rate of learning, having more time to reflect, feeling more in control of the learning process, and engaging in more self-directed and independent learning (Thomson, 2010).

In the United States, there exists a nationally available program called *talent search* that plays a substantial role in educating gifted children but is not sponsored by public schools (Olszewski-Kubilius, 1998b, 2008b). Begun in the 1970s, talent search programs involve testing children anywhere from grades 3 through 9 who are performing at the 90th to 95th percentile or above on a standardized in-grade achievement test via standardized tests that are given off-level (e.g., tests designed for and typically give to older kids). Underlying talent search is the premise that grade-level tests cannot adequately measure their abilities, which are typically beyond grade level standards. Subsequent programs (e.g., summer, weekend, and distance learning programs) and services are geared to talent search students' advanced abilities and knowledge. The most well developed programs involve having seventh- and eighth-grade students take the SAT or the American College Test (ACT). It is estimated that more than 150,000 gifted students across the United States participate in talent search programs annually (Lee, Matthews, & Olszewski-Kubilius, 2008).

Talent search testing and subsequent programs are among the most researched models of identification of academic talent and service delivery that exist within the field of gifted education (Olszewski-Kubilius, 1998b; 2008b; Olszewski-Kubilius & Lee, 2008). Research has validated the use of the cutoff scores on grade level achievement tests for participation in the talent search and the predictive validity of scores on off-level tests such as the SAT for performance in accelerated classes for middle school students (Olszewski-Kubilius, 1998b, 2008b). Talent search scores are also predictive of future accomplishments such as grades and course taking in high school (see Olszewski-Kubilius & Lee, 2008, for a review of this research); they are also predictive of choice of field of study in graduate school and creative accomplishments in early career (Park, Lubinski, & Benbow, 2007; Wai et al., 2005).

Although institutions other than the local schools are increasingly serving gifted students through programs and courses, there is very little articulation between in-school and out-of-school programs. Many students take courses in university summer programs for their own personal growth and enrichment and do not expect to receive credit from their school. Increasingly, however, students and families use summer programs and distance education programs to complete required high school courses or to complete advanced courses that can fulfill graduation requirements. Credit for summer or online is infrequently given for a variety of reasons (Lee & Olszewski-Kubilius, 2005). At present, schools and out-of-school institutions that serve gifted students through programs work independently rather than cooperatively. With more and more high schools looking to blended and hybrid e-learning as a way to reduce costs but maintain a comprehensive curriculum and higher education institutions using distance education to attract more and a varied student body, there may be more openness and acceptance on the part of educators to nontraditional educational options of all kinds. Schools may be more willing to accept credits earned outside of their walls and may even encourage students to seek alternatives that they cannot provide. Outside-of-school programs are not constrained by requirements for testing and evaluation or covering particular curricula the way public schools are and therefore can offer unique enrichment experiences to students. Ideally, schools can emulate and incorporate some of the features of outside-of-school programs such as student choice, project oriented, authentic products, instruction by professionals and community experts, into their curricula and programming.

The Future of Gifted Education

At present, there continues to be a shift away from school-based special programs to serving gifted students via cluster grouping models within heterogeneous classrooms. This is due largely to a current emphasis on differentiation within education as a general instructional strategy for meeting the diverse learning needs of all students. Research cited previously suggests that although having the regular teacher meet the needs of gifted students within the classroom sounds good in theory, it is difficult to implement, and without substantial training and support, little real differentiation of curriculum and instruction often actually takes place (Delcourt, Loyd, Cornell, & Goldberg, 1994). A question for practitioners and researchers within gifted education is “What does differentiation look like for a gifted learner?” Are so-called gifted practices, such as problem-based learning or a focus on higher level thinking appropriate for all students? Is there a gifted pedagogy beyond adjustments in pacing of instruction and acceleration?

The research on talent development has shown that schools and the process by which high levels of talent are developed are often at odds. For example, the retrospective literature on eminent adults shows a pattern of early specialization in the talent area and education more akin to apprenticeships and mentorships, unlike our current traditional schooling (Dixon, Gallagher, & Olszewski-Kubilius, 2009; Sosniak, 1999; Subotnik & Coleman, 1996). Other features of a talent development approach to schooling would be flexible pacing of instruction, including acceleration, tailored to students capabilities; placement and grouping of students based on knowledge and mastery and not chronological age; instruction that emphasizes discipline specific methods of inquiry; models that allow students to make continuous progress in a subject area even if this means crossing levels of schooling early or skipping grades; use of distance education to increase breadth of the curriculum and enable acceleration; and use of outside-of-school programs to provide mentors, and authentic learning experiences and career awareness. Shifting to a talent development approach to education will require dealing with strongly held beliefs such as that education should promote well-roundedness or that age-based groupings are optimal for social development. Gifted education and the talent development literature may have much to say to those who wish to reformulate schools so that all children are motivated to learn to their highest potential.

The shift in the field to a focus on talent development acknowledges a broader conception of intelligence beyond IQ; recognizes that talent emerges and develops at different rates for children depending upon opportunity and context; affirms that noncognitive factors are equally as important as cognitive ones in the fruition of talent, especially motivation; and promotes the idea that different kinds of programs, supports and interventions are needed at different points along the path of talent development and should address not only discipline specific learning but the development of other personal qualities necessary for sustained high achievement such as persistence and self-regulation. This perspective is consistent with school reform efforts that emphasize that schools are living systems, that individualization and personalization of learning are critical to developing motivation and school success, and that schools must address the whole child (McComb, this volume).

The major issue facing education today is the achievement gap between poor and more advantaged children and minority and nonminority children and this is a focus of much of the school reform movement. Gifted programs have been criticized for under identifying students of color and for contributing to the inequities that exist in schools regarding the education of poor and minority children (Sapon-Shevin, 1996). Research and programmatic efforts related to the achievement gap have largely focused on bringing up the achievement of the lowest performing students, schools, or districts rather than pushing more students toward the highest levels of achievement. However, African Americans, Latinos, and Native Americans are severely underrepresented among the top 1%, 5%, and 10% of students on almost every achievement measure including grades, GPA, class rank and standardized test scores and at every level of education from kindergarten through graduate and professional school (Miller, 2004; Plucker, Burroughs, & Song, 2010). Differences in achievement between racial/ethnic groups are not solely attributable to SES; some of the largest gaps between the achievement of minority and nonminority children are among students who have parents with bachelor, graduate, or professional degrees and these differences can be found prior to the first grade (Miller, 2004). Additionally, since the passage of the No Child Left Behind Act, which was designed to address the achievement gap, the lowest achieving students made rapid gains from 2000 to 2007, while the highest achieving students made minimal gains (Loveless, Farkas, & Duffett, 2008). Specifically, using data from the National Assessment of Educational Progress study (NAEP), Loveless et al. (2008), found that among students who scored in the bottom 10%, math and reading scores increased for fourth graders and math scores improved for eighth graders since 2000, while scores for the top 10% of students, those scoring above the 90th percentile, have changed little. Plucker, Burroughs, and Song (2010), based on a state-by-state analysis of performance on state-level exams and NAEP data, suggest the existence of an "excellence gap" or widening disparities in the number of students who are economically disadvantaged, English Language learners, and historically under-represented minorities reaching the highest levels of achievement.

School does little to close achievement gaps. Recent research shows that lower income students who start school achieving at higher levels (top 25%) are less likely to maintain their status as a high achiever as they go through elementary school (Wyner et al., 2007). Low-income children who are not in the top academic quartile in first grade are far less likely to rise to those levels as they progress through elementary and middle school compared to their higher income counterparts. Lower income, higher achieving students are less likely to graduate from college or attend the most selective colleges and are more likely to attend the least selective colleges and not to graduate from these schools compared to their more advantaged counterparts (Wyner et al., 2007).

The demographics of the school population in the United States are changing. As school reform efforts work to make sure that diverse perspectives are valued, that the cultures of students are reflected in curriculum and responded to by teachers in their instructional practices, and that all children achieve, the diversity among gifted learners must be acknowledged (McComb, this volume). School reform cannot remain primarily focused on minimum levels of competency for students and must include equal emphasis on moving students to the highest levels of achievement possible, especially those with exceptional potential.

Another lesson from the studies of talented individuals is the important role of out-of-school agencies in developing talent. Many parents who have financial resources seek additional services and programs for their talented children from universities, summer camps, and other organizations. However, tuition costs make lack of access an important issue and potentially can increase the inequities between talented students of varying economic levels. In 2008 to 2009, only 20 states in the United States provided state funds for special summer programs for advanced students, often called *governor's schools* (NAGC, 2009). An important role for gifted education is forging a closer connection between schools and community organizations and institutions in the service of educating talented children. Articulation and cooperation between outside-of-school agencies and schools is critical if significant aspects of talent development take place beyond the school walls and if community programs can provide critical experiences that schools cannot, such as access to and instruction by practicing professionals. It is not unusual for schools to deny students credit or appropriate placement for courses that they have taken outside their local school (Lee & Olszewski-Kubilius, 2005). Concerns about the quality of outside courses and "seat time" affect schools' decisions about credit and placement, but if schools cannot provide the needed courses at the appropriate time for gifted students (which may mean earlier than for most students), they must be more willing to work with outside agencies to do so. The boundaries between levels of schooling must become more fluid and the dependence on age for placement into classes less rigid to meet the needs of gifted children. For example, currently only 29 states specifically permit gifted students to be dually enrolled in high school and college, and only 17 of these permit dual enrollment for students younger than grade 11. Only eight states specifically permit middle school students to earn high school credit via dual enrollment in high school (NAGC). Increased cooperation and collaboration between different levels of schooling and between schools and community organizations for the purposes of talent development can facilitate the transformation of schools from isolated institutions to true communities of practice (McComb, this volume).

Another theme that emerges from the research on practices in gifted education is the importance of teacher training. In the Archambault et al. (1993) study cited earlier, 61% of the teachers had not had any inservice training in gifted education despite the fact that their average length of teaching was 10 years. Only 18 states in the United States currently require teachers to have special endorsements or certificates to teach gifted students (NAGC, 2009). Preservice training in gifted education typically consists of a few hours of instruction within the Exceptional Children course, and is only required in five states. Only when there is recognition that meeting the educational needs of gifted students does require special techniques and methods that must be specifically taught to and acquired by teachers will this situation change. This is especially critical since most gifted children are now served in heterogeneous classrooms (NAGC, 2009) by regular teachers. Additionally, many of the best practices promoted by the field of gifted education, including problem based learning, a focus on independent inquiry and authentic, meaningful projects and products, learning and using the tools of the practicing professionals, and learning centered on the major concepts and big ideas underlying and connecting the disciplines (VanTassel-Baska & Little, 2011) are consistent with those called for by school reform proponents.

A final issue that will continue to significantly affect gifted education is the increasing presence of distance education options and their role in helping local school districts to meet the educational needs of gifted students. As of 2008, online learning programs at the K-12 level were available in 44 states and several others were in the planning stages (Watson, Gemin, & Ryan, 2008). Several of these are designed for gifted students specifically offering accelerated pacing and advanced classes (Olszewski-Kubilius, 2008a). Distance education has the potential to completely reorganize the way special advanced classes can be offered and increase access to them dramatically (Thomson, 2010). It also has the potential to relegate gifted education to outside agencies as schools find it easier to use these programs in lieu of making substantial accommodations in their basic curricula and programs. From a broader perspective, new technologies, including those that support distance education and enable it to be a multifaceted and rich learning experience, have significantly altered the way in which learning environments can be constructed. Technologies affect how students learn, how they demonstrate their learning, and with whom they learn. They will be the tools that teachers use to individualize, differentiate and personalize learning for students in the future and are a critical component of efforts to reform education.

Despite the research presented in this chapter, there is a paucity of studies on the effectiveness and outcomes of different types of program models—particularly at the secondary level. Specifically, research on cooperative programs between schools and community institutions or schools and universities is needed as well as research about program models that effectively serve a diverse group of gifted children. Many innovative approaches are being tried, but few are being tested and adequately evaluated. Although there is considerable research on several practices within the field, the literature on best practices is still relatively limited.

Along with best practices, more research is needed on the types of training and professional development models that help teachers to acquire the skills they need. And finally, more research is needed on why attitudes toward certain practices such as acceleration continue to be negative despite the overwhelming positive research support for the practice. Research is sorely needed on how to use research in this field to effect change and affect school policies and classroom practices.

REFERENCES

Abuhamdeh, S., & Csikszentmihalyi, M. (2004). The artistic personality: A systems approach. In R. J. Sternberg, E. L. Grigorenko, & Singer, J. L. (Eds.), *Creativity. From potential to realization* (pp. 31–42). Washington, DC: American Psychological Association.

Archambault, F. X. Jr., Westberg, K. L., Brown, S. W., Hallmark, B. W., Emmons, C. L., & Zhang, W. (1993). *Regular classroom practices with gifted students: Results of a national survey of classroom teachers.* Storrs: University of Connecticut.

Berger, S. L. (2008). *The ultimate guide to summer opportunities for teens*. Waco, TX: Prufrock Press.

Bloom, B. S. (Ed.). (1985). *Developing talent in young people.* New York, NY: Ballantine.

Borland, J. H. (2003). The death of giftedness. In J. H. Borland (Ed.), *Rethinking gifted education* (pp. 105–124). New York, NY: Teachers College Press.

Borland, J. H., Schnur, R., & Wright, L. (2000). Economically disadvantaged students in a school for the academically gifted: A post-positivist inquiry into individual and family adjustment. *Gifted Child Quarterly, 44*(1), 13–32.

Colangelo, N., Assouline, S., & Gross, M. (Eds). (2004). *A nation deceived: How schools hold back America's brightest students* (pp. 109–117). Iowa City: University of Iowa.

Cox, C. (1926). *Genetic studies of genius: Vol. 1. The early mental traits of three hundred geniuses.* Stanford, CA: Stanford University Press.

Cramond, B. (1994). The Torrance tests of creative thinking: From creation through establishment of predictive validity. In R. F. Subotnik & K. D. Arnold (Eds.), *Beyond Terman: Longitudinal studies in contemporary education* (pp. 229–254). Norwood, NJ: Ablex.

Cramond, B. (2005). A report on the 40-year follow-up of the Torrance tests o creative thinking: Alive and well in the new millennium, *Gifted Child Quarterly, 49*(4), 283–291.

Csikszentmihalyi, M. (1994). The domain of creativity. In D. H. Feldman, M. Csikszentmihalyi, & H. Gardner (Eds.), *Changing the world. A framework for the study of creativity* (pp. 135–158). Westport, CT: Praeger.

Csikszentmihalyi, M., & Robinson, R. E. (1986). Culture, time and the development of talent. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 264–284). Cambridge, UK: Cambridge University Press.

Delcourt, M. A. B., Cornell, D. G., & Goldberg, M. D. (2007). Cognitive and affective learning outcomes of gifted elementary school students. *Gifted Child Quarterly Fall, 51*, 359–381.

Delcourt, M. A. B., Loyd, B. H., Cornell, D. G., & Goldberg, M. D. (1994). *Evaluation of the effects of programming arrangements on student learning outcomes.* Storrs, CT: University of Connecticut.

Dixon, F. A., Gallagher, S. A., & Olszewski-Kubilius, P. (2009). Part III. A visionary statement for the education of gifted students in secondary schools. In F. A. Dixon (Ed.) *Programs and services for gifted secondary students* (pp. 173–184). Waco, TX: Prufrock Press.

Ericsson, K. A. (1996). The acquisition of expert performance: An introduction to some of the issues. In K. A. Anders (Ed.), *The road to excellence. The acquisition of expert performance in the arts and sciences, sports and games* (pp. 1–50). Mahwah, NJ: Erlbaum.

Ericsson, K. A. (2001). The acquired nature of expert performance: Implications for conceptions of giftedness and innate talent? In N. Colangelo & S. G. Assouline (Eds.), *Talent Development IV. Proceedings from the 1998 Henry B. and Jocelyn Wallace National Research Symposium on Talent Development* (pp. 11–26). Scottsdale, AZ: Great Potential Press.

Feldman, D. H. (1986). *Nature's gambit. Child prodigies and the development of human potential.* New York, NY: Basic Books.

Feldman, D. H. (2008). Prodigies. In J. A. Plucker & C. M. Callahan (Eds.), *Critical issues and practices in gifted education* (pp. 523–534). Waco, TX: Prufrock Press.

Ford, D. Y. (1996). *Reversing underachievement among gifted black students.* New York, NY: Teachers College Press.

Gagne, F. (2003). Transforming gifts into talents: The DMGT as a developmental theory. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (3rd ed., pp. 60–87). Boston, MA: Pearson.

Gagne, F. (2005). From gifts to talents: The DMGT as a developmental model. In R. J. Sternberg & J. E. Davis (Eds.), *Conceptions of giftedness* (2nd ed., pp. 98–119). New York, NY: Cambridge University Press.

Gagne, F. (2009). Building gifts into talents: Detailed overview of the DMGT 2.0. In B. McFarlane & T. Stambaugh (Eds.), *Leading change in gifted education* (pp. 61–80). Waco, TX: Prufrock Press.

Gardner, H. (1983). *Frames of mind. The theory of multiple intelligences.* New York, NY: Basic Books.

Gentry, M. L., & Owen, S. V. (1999). An investigation of the effects of total school flexible cluster grouping on identification, achievement, and classroom practices. *Gifted Child Quarterly, 43*, 224–243.

Goertzel, V., & Goertzel, M. G. (1962). *Cradles of eminence.* Boston, MA: Little, Brown.

Gottfried, A. W., Gottfried, A. E., Bathurst, K., & Guerin, D. W. (1994). *Gifted IQ. Early developmental aspects. The Fullerton Longitudinal Study.* New York, NY: Plenum Press.

Hunsaker, S. L. (2005). Outcomes of creativity training programs. *Gifted Child Quarterly, 49*(4), 292–299.

Karnes, F. A., & Marquardt, R. G. (2000). *Gifted children and legal issues.* Scottsdale, AZ: Gifted Psychology Press.

Karnes, F. A., & Riley, T. L. (2005). *Competitions for talented kids*. Waco, TX: Prufrock Press.

Kiernan, V. (2005). *Finding an online high school*. Alexandria, VA: Mattily.

Kulik, J. A. (1992). *An analysis of the research on ability grouping: Historical and contemporary perspectives.* Storrs: University of Connecticut.

Kulik, C. L. C., & Kulik, J. A. (1992). Effects of ability grouping on secondary school students: A meta-analysis of evaluation findings. *American Educational Research Journal, 19*, 415–428.

Lee, S. Y., Matthews, M. S., & Olszewski-Kubilius, P. (2008). A national picture of talent search and talent search educational programs. *Gifted Child Quarterly, 52*(1), 55–69.

Lee. S. Y., & Olszewski-Kubilius, P. (2005). Investigation of high school credit and placement for summer coursework taken outside of local schools. *Gifted Child Quarterly, 49*(1), 37–50.

Lohman, D. F. (2005). The role of nonverbal ability tests in identifying academically gifted students: An aptitude perspective. *Gifted Child Quarterly, 49*(2), 111–138.

Lohman, D. F., Korb, K. A., & Lakin, J. M. (2008). Identifying academically gifted English-language learners using nonverbal tests: A comparison of the Raven, NNAT, and CogAT. *Gifted Child Quarterly, 52*(4), 275–298.

Loveless, T., Farkas, S., & Duffett, A. (2008). *High-achieving students in the era of NCLB*. Washington, DC: Fordham.

Lubart, T. I. (2003). In search of creative intelligence. In R. J. Sternberg, J. Lautrey, & T. I. Lubart (Eds.), *Models of intelligence. International Perspectives* (pp. 279–293). Washington, DC: American Psychological Association.

Lubinski, D., & Benbow, C. P. (2006). Study of mathematically precocious youth after 35 years: Uncovering antecedents for the development of math-science expertise. *Perspectives on Psychological Science, 1*(4), 316–345.

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education, 32*(5), 669–685.

Marland, S. P. (1972). *Education of the gifted and talented: Report to the Congress of the United States by the U.S. Commission of Education.* Washington, DC: U.S. Government Printing Office.

Marsh, H. W., & Hau, K. (2003). Big-fish-little-pond effect on academic self-concept: A cross-cultural (26-country) test of the negative effects of academically selective schools. *American Psychologist, 58*, 364–376. doi: 10.1037/0003-066X.58.5.364

Marsh, H. W., Chessor, D., Craven, T., & Roche, L. (1995). The effects of gifted and talented programs on academic self-concept: The big fish strikes again. *American Educational Research Journal, 32*, 285–319.

Matthews, D., & Kitchen, J. (2007). School-within-a-school gifted programs: Perceptions of students and teachers in public secondary schools. *Gifted Child Quarterly Summer, 51*, 256–271.

McCarthy, C. (1999). Dual enrollment programs: Legislation helps high school students enroll in college courses. *Journal of Secondary Gifted Education, 11*(2), 24–32.

Meador, K. S., Fishkin, A. S., & Hoover, M. (1999). Research-based strategies and programs to facilitate creativity. In A. S. Fishkin, B. Cramond, & P. Olszewski-Kubilius (Eds.), *Investigating creativity in youth* (pp. 389–416). Cresskill, NJ: Hampton Press.

McCluskey, K. W., Baker, P. A., & McCluskey, A. L. A. (2005). Creative problem solving with marginalized populations: Reclaiming lost prizes through in-the-tranches interventions. *Gifted Child Quarterly, 49*(4), 330–341.

Milgram, R. M. (2003). Challenging out-of-school activities as a predictor of creative accomplishments in art, drama, dance and social leadership. *Scandanavian Journal of Educational Research, 47*, 305–315.

Miller, L. S. (2004). *Promoting sustained growth in the representation of African Americans, Latinos, and Native Americans among top* *students in the United States at all levels of the education system*. Storrs, CT: National Research Center on the Gifted and Talented.

Morelock, M. J., & Feldman, D. H. (2003). Extreme precocity: Prodigies, savants, and children of extraordinarily high IQ. In N. Colangelo & G. A Davis (Eds.), *Handbook of gifted education* (3rd ed., pp. 455–469). Boston, MA: Pearson.

Muratori, M. (2007). *Early entrance to college. A guide to success.* Waco, TX: Prufrock Press.

National Association for Gifted Children. (2009). *2008–2009 state of the states: A report by the national association for gifted children and the council of state directors of programs for the gifted.* Washington, DC: Author.

Neihart, M. (2007). The socioaffective impact of acceleration and ability grouping: Recommendations for best practice. *Gifted Child Quarterly, 51*, 330–341.

Olszewski-Kubilius, P. (1995). A summary of research regarding early college entrance. *Roeper Review, 18*(2), 121–125.

Olszewski-Kubilius, P. (1998a). Early entrance to college: Students' stories. *Journal of Secondary Gifted Education, 10*, 226–247.

Olszewski-Kubilius, P. (1998b). Research evidence regarding the validity and effects of talent search educational programs. *Journal of Secondary Gifted Education, 9*(3), 134–138.

Olszewski-Kubilius, P. (2000). The transition from childhood giftedness to adult creative productiveness: Psychological characteristics and social supports. *Roeper Review, 23*(2), 65–71.

Olszewski-Kubilius, P. (2008a). Distance education. In F. A. Dixon (Ed.), *Programs and services for gifted secondary students* (pp. 163–172). Waco, TX: Prufrock Press.

Olszewski-Kubilius, P. (2008b). Talent search programs for gifted adolescents. In F. A. Dixon (Ed.), *Programs and services for gifted secondary students* (pp. 149–156). Waco, TX: Prufrock Press.

Olszewski-Kubilius, P. (2010). Special schools and other options for gifted STEM students. In a special issue of the Roeper Review on STEM talent development, edited by T. Cross, C. Kolar, P. Olszewski-Kubilius, & R. Subotnik, *32*, 61–70.

Olszewski-Kubilius, P., & Lee. S. Y. (2004). Gifted adolescents' talent development through distance learning. *Journal for the Education of the Gifted, 28*(1), 7–35.

Olszewski-Kubilius, P., & Lee. S. Y. (2008). Specialized programs serving the gifted. In F. A. Karnes & K. P. Stephens (Eds.), *Achieving excellence. Educating the gifted and talented* (pp. 192–208). Columbus, OH: Pearson.

Olszewski-Kubilius, P., & Limburg-Weber, L. (1999). *Designs for excellence: A guide to educational program options for academically talented middle school and secondary school students.* Evanston, IL: Center for Talent Development, Northwestern University.

Olszewski-Kubilius, P., & Thomson, D. (2010). Gifted programming for poor or minority urban students: Issues and lessons learned. *Gifted Child Today, 33*(4), 58–65.

Park, G. Lubinski, D., & Benbow, C. P. (2007). Contrasting intellectual patterns predict creativity in the arts and sciences. Tracking intellectually precocious youth over 25 years. *Psychological Science, 18*(11), 948–952.

Park, G. Lubinski, D., & Benbow, C. P. (2008). Ability differences among people who have commensurate degrees matter for scientific creativity. *Psychological Science, 19*(10), 957–961.

Plucker, J. A., Burroughs, N., & Song, R. (2010). *Mind the (other) gap!* Bloomington: Indiana University, Center for Evaluation and Education Policy.

Pressey, S. L. (1949). *Educational acceleration: Appraisal of basic problems.* Bureau of Educational Research Monograph No. 31. Columbus, OH: Ohio State University Press.

Pyryt, M. C. (1999). Effectiveness of training children's divergent thinking: A meta-analytic review. In A. S. Fishkin, B. Cramond, & P. Olszewski-Kubilius (Eds.), *Investigating creativity in youth* (pp. 351–366). Cresskill, NJ: Hampton Press.

Renzulli, J. (2008). Teach to the top: How to keep high achievers engaged and motivated. Instructor, *117*(5), 24.

Renzulli, J. S. (2003). Conception of giftedness and its relationship to the development of social capital. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (3rd ed., pp. 75–87). Boston, MA: Pearson.

Renzulli, J. S. (2005). Three ring conception of giftedness. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (2nd ed., pp. 246–279). New York, NY: Cambridge University Press.

Renzulli, J. S., & Reis, S. M. (1986). The enrichment triad/revolving door model: A schoolwide plan for the development of creative productivity. In J. S. Renzulli (Ed.), *Systems and models for developing programs for the gifted and talented* (pp. 216–266). Mansfield Center, CT: Creative Learning Press.

Robinson, N. M. (2005). In defense of a psychometric approach to the definition of academic giftedness: A conservative view from a die-hard liberal. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (2nd ed., pp. 280–294). New York, NY: Cambridge University Press.

Roe, A. (1953). *The making of a scientist.* New York, NY: Dodd, Mead.

Rogers, K. B. (1991). *The relationship of grouping practices to the education of the gifted and talented learner.* Storrs: University of Connecticut.

Rogers, K. B. (2002). *Re-forming gifted education*. Scottsdale, AZ: Great Potential Press.

Rogers, K. B. (2007). Lessons learned about educating the gifted and talented: A synthesis of the research on educational practice. *Gifted Child Quarterly, 51*, 382–396.

Rogers, K. B., & Span P. (1993). Ability grouping with gifted and talented students: Research and guidelines. In K. Heller, F. Mönks, & A. H. Passow (Eds.), *International handbook of research and development of giftedness and talent* (pp. 585–592). Tarrytown, NY: Pergamon Press.

Sapon-Shevin, M. (1996). Beyond gifted education: Building a shared agenda for school reform. *Journal for the Education of the Gifted, 19*(20), 194–214.

Sarouphim, K. M. (2002). DISCOVER in high school: Identifying gifted Hispanic and Native American students. *Journal of Secondary Gifted Education, 14*, 30–38.

Sayler, M. F. (2006). Special schools for the gifted and talented. In F. A. Dixon & S. M. Moon (Eds.), *The handbook of secondary gifted education* (pp. 547–559). Waco, TX: Prufrock.

Schiever, S. W., & Maker, C. J. (2003). New directions in enrichment and acceleration. In N. Colangelo & G. A. Davis, *Handbook of gifted education* (pp. 163–173). Boston, MA: Pearson.

Sosniak, L. (1999). An everyday curriculum for the development of talent. *Journal of Secondary Gifted Education, 10*(4), 166–172.

Southern, W. T., & Jones, E. D. (2004). Types of acceleration: Dimensions and issues. In N. Colangelo, S. Assouline, & M. Gross (Eds.), *A nation deceived: How schools hold back America's brightest students* (pp. 5–12). Iowa City: University of Iowa.

Southern, W. T., Jones, E. D., & Stanley, J. C. (1993). Acceleration and enrichment: The context and development of program options. In K. A. Heller, F. J. Monks, & A. H. Passow (Eds.), *International handbook of research and development of giftedness and talent* (pp. 387–410). New York, NY: Pergamon Press.

Sternberg, R. J. (1986). A triarchic theory of intellectual giftedness. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 223–243). New York, NY: Cambridge University Press.

Sternberg, R. J. (2005). The WICS model of giftedness. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 327–342). New York, NY: Cambridge University Press.

Sternberg, R. J., & Davidson, J. E. (Eds.). (2005). *Conceptions of giftedness* (2nd ed.). New York, NY: Cambridge University Press.

Sternberg, R. J., Grigorenko, E. L., & Singer, J. L. (Eds.). (2004). *Creativity. From potential to realization*. Washington, DC: American Psychological Association.

Sternberg, R. J., & Lubart, T. I. (1995). *Defying the crowd: Cultivating creativity in a culture of conformity*. New York, NY: Free Press.

Subotnik, R. F., & Arnold, K. D. (1994). *Beyond Terman. Contemporary longitudinal studies of giftedness and talent.* Norwood, NJ: Ablex.

Subotnik, R. F., & Coleman, L. J. (1996). Establishing the foundations for a talent development school: Applying principles to creating an idea. *Journal for the Education of the Gifted, 20*(2), 175–189.

Subotnik, R. F., & Jarvin, L. (2005). Beyond expertise: Conceptions of giftedness as great performance. In. R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of Giftedness* (2nd ed., pp. 343–357). New York, NY: Cambridge University Press.

Subotnik, R. F., Karp, D. E., & Morgan, E. R. (1989). High IQ children at mid-life: An investigation into the generalizability of Terman's "Genetic Studies of Genius." *Roeper Review, 11*(3), 139–144.

Subotnik, R. F., Miserandino, A., & Olszewski-Kubilius, P. (1997). Implications of the Mathematics Olympiad studies for the development of mathematical talent in schools. *International Journal of Educational Research, 25*(6), 563–573.

Tannenbaum, A. J. (2003). Nature and nurture of giftedness. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (3rd ed., pp. 45–59). Boston, MA: Pearson.

Terman, L. M. (1925). *Genetic studies of genius: Vol. 1. Mental and physical traits of a thousand gifted children.* Stanford, CA: Stanford University Press.

Terman, L. M., & Oden, M. H. (1947). *Genetic studies of genius: Vol. 4. The gifted child grows up: Twenty-five years follow-up of a superior group.* Stanford, CA: Stanford University Press.

Terman L. M., & Oden, M. H. (1957). *Genetic studies of genius: Vol. 5. The gifted group at mid-life; Thirty-five years' follow-up of the superior child.* Stanford, CA: Stanford University Press.

Thomas, J., & Williams, C. (2010). The history of specialized STEM schools and the formation and role of the NCSSSMST. *Roeper Review, 32*, 17–24.

Thomson, D. L. (2010). Beyond the Classroom Walls: Teachers' and Students' Perspectives on the Key Instructional Practices that Facilitate a Successful Online Learning Experience for Gifted Students. *Journal of Advanced Academics, 21*(4), 662–712.

U.S. Department of Education. (1993). *National excellence: A case for developing America's talent.* Washington, DC: Author.

VanTassel-Baska, J. (1998). Key issues and problems in secondary programming. In J. VanTassel-Baska (Ed.), *Excellence in educating gifted & talented learners* (pp. 241–260). Denver, CO: Love.

VanTassel-Baska, J., Feng, A. X., & Evans, B. L. (2008). Patterns of identification and performance among gifted students identified through performance tasks: A three-year review, *Gifted Child Quarterly, 51*(3), 218–231.

VanTassel-Baska, J., & Little, C. A. (2011). (Eds.). Content-based curriculum for high-ability learners (2nd ed.). Waco, TX: Prufrock Press.

Wai. J., Lubinski, D., & Benbow, C. P. (2005). Creativity and occupational accomplishments among intellectually precocious youths: An age 13 to age 33 longitudinal study. *Journal of Educational Psychology, 97*(3), 484–492.

Watson, J., Gemin, B., & Ryan, J. (2008). Keeping pace with K-12 online learning. A review of state-level policy & practice. www.kpk12.com/

Wyner, J. S., Bridgeland, J. M., & Diiulio Jr., J. J. (2007). *Achievement trap: How America is failing millions of high-achieving students from low-income families.* Lansdowne, VA: Jack Kent Cooke Foundation.

Zuckerman, H. (1977). *Scientific elite: Nobel laureates in the United States.* New York, NY: Free Press.

CHAPTER 17

The School-Related Behavior Disorders Field: A Source of Innovation and Best Practices for School Personnel Who Serve Students With Emotional and Behavioral Disorders

HILL M. WALKER AND FRANK M. GRESHAM

The focus of this chapter is on the social, emotional, and behavioral disorders of children and youth, which are increasingly manifested within the context of schooling. Children by the thousands now appear at the schoolhouse door showing the damaging effects of prior exposure to family-based and societal risks during the first 5 years of life (e.g., abuse, neglect, chaotic family conditions, crime ridden neighborhoods, media violence). Our society has begun to reap a bitter harvest of longer-term, destructive outcomes among our most vulnerable children and youth resulting from such risk exposure and from our seemingly diminished capacity to competently rear, socialize, and care for them effectively. It is now not uncommon for as many as half of all the newborns in any given U.S. state to suffer one or more risk factors for later destructive outcomes and poor health (Kitzhaber, 2001). The more severe these risks are and the more of them one is exposed to over the long term (i.e., the first 5 years of life), the greater is their likely negative impact (Biglan, 2001; Walker, Ramsey, & Gresham, 2004).

The characteristics, needs, and demands of these children and youth have overwhelmed the capacity of schools to accommodate them effectively (Shinn & Walker, 2010). Ironically, our school systems have been relatively slow to recognize the true dimensions of the challenges that these students pose to themselves, to school personnel, to the non-school-affiliated social agents in their lives, and to the larger society (Walker et al., 2004). Recent estimates by experts of the number of today's youth with significant mental health problems reflect the accumulating destructive changes that have occurred in the social and economic conditions of our society over the past four decades or so.

Angold (2000), for example, has estimated that approximately 20% of today's school-age children and youth could qualify for a psychiatric diagnosis using criteria from the *Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition* (*DSM-IV;* American Psychological Association, 1994). Similarly, Hoagwood and Erwin (1997) have argued persuasively that about 22% of children and youth enrolled in school settings have mental health problems that warrant serious attention and treatment. More recently, Burns and Hoagwood (2002) have made a similar case and they noted that 75% of these students are dependent upon schools for access to mental health services. Cast against these prevalence rates is the fact that, for the past 20 years, slightly less than 1% of the school-age population has been identified, certified, and subsequently served as emotionally or behaviorally disordered (EBD) under provisions of the appropriate, federal authorizing legislation (Individuals with Disabilities Act, IDEA, 1997). This persistent finding illustrates the enormous and quite stable gap that exists between need and available supports and services for these students in the school setting (Severson, Walker, Hope-Doolittle, Kratochwill, & Gresham, 2007; Walker, Nishioka, Zeller, Bullis, & Sprague, 2001; Walker, Severson, & Seeley, 2010).

In a decade-old *Washington Post* investigative report on the changed landscape of problem behavior and its impact on schooling, Perlstein (2001) extensively documented the outrageous forms of behavior displayed by younger and younger children and concluded that our schools are "awash in bad behavior" (p. B1). She described urban elementary school students who defied their teachers and called them obscene names, who threatened them with physical violence, who attacked their peers for no apparent reason, who brought drugs and weapons to school, who destroyed classroom furnishings when disciplined, and whose parents denied their child's culpability in these incidents and refused to take ownership or responsibility for dealing with them. Teachers are frequently targeted for blame in such situations and, unfortunately, are too often not adequately supported by administrators in resolving them.

Perlstein provided compelling evidence of national trends involving the rising use of school suspensions and expulsions of very young children, the creation of school-based detention centers, and investment in alternative educational programs and personnel—all increasing substantially at the elementary school level. In our view, the fiscal and social drivers of this situation are worse today than they were at the time of Perlstein's report. Educators today broadly perceive the costs of these accommodations as taking dollars away from needed school reform efforts designed to increase educational accountability and student achievement levels.

It seems clear that thousands of young children in our society are being socialized within chaotic, abusive family and community contexts in which they are exposed to a host of risk factors that provide a fertile breeding ground for the development of highly maladaptive attitudes, beliefs, and behavioral forms. These risk factors can operate in multiple ways on an individual across family, community, school, and societal contexts. They are registered in unfortunate life paths that are often tragic and involve huge social and economic costs. We now see comorbid mixtures of syndromes (e.g., conduct disorder and attention-deficit/hyperactivity disorder) in school-age children that are efficient predictors of adult psychopathology (see Gresham, Lane, & Lambros, 2000; Lynam, 1996; Seeley, Rohde, & Jones, 2010).

As a result of deep societal concerns about our troubled children and youth, federal agencies have assembled experts from multiple disciplines to create policy, develop legislative initiatives, and construct action plans that will address this growing national problem. For example, in September 2000, the U.S. Surgeon General convened a national conference on children's mental health, involving collaboration between the U.S. Departments of Health and Human Services, Education, and Justice. Its overarching goal was to develop a national action plan that balances health promotion, disease prevention, early detection, and universal access to care. This conference produced an influential report titled *Report of the Surgeon General's Conference on Children's Mental Health: A National Action Agenda*, which provided a blueprint for action on this critically important topic. Although influential at the time of its release, when looking back at the impact of this report over the past decade, it now seems clear that it has been relatively weak in effecting the delivery of cost-effective mental health services to children and youth—especially within school contexts.

In a more reactive vein, the widely publicized school shooting tragedies of the 1990s have shocked us into action and cast a national spotlight on the problems that young people daily experience with bullying, emotional abuse, and harassment at the hands of their peers. It is consistently estimated in media reports that well over 100,000 U.S. students miss school each day because of bullying (see Espelage & Swearer, 2003, 2010). Relational aggression, which is a more subtle form of bullying, has recently emerged as a widespread, serious problem in schooling contexts among both boys and girls. This form of bullying seeks to isolate and punish individuals (who are targeted by peers) through such means as social exclusion, reputational trashing, deception, and social cruelty. Further, the emergence of cyber technology makes it possible for this most pernicious form of bullying to expand beyond the school setting and become viral. For example, one individual can now assume differing identities through this technology and send a series of negative messages to a targeted individual that appear to come from unlimited, multiple sources. Leff et al. (2009) contributed an excellent, special series of articles on this important topic in the journal, *School Psychology Review*.

When mixed with pervasive mental health problems (severe stress and anxiety, depression, paranoia) and the desensitizing effects of exposure to violent images in the media, the toxic consequences of bullying can pose a real risk of tragic outcomes in the context of an abused student seeking revenge—a recurring pattern that we have seen in school shootings. Kip Kinkle, for example, who went on a school-shooting rampage at Thurston High School in Springfield, Oregon, in 1998, after murdering his parents the day before, was an exemplar of this combination of destructive attributes. The Thurston shooting prompted a collaborative effort between the U.S. Departments of Education and Justice (in which the senior author was a participant) that created a national panel of experts who produced two school safety resource guides sent to every school in the country: *Early Warning/Timely Response: A Guide to Safe Schools* and *Safeguarding Our Children: An Action Guide. Implementing Early Warning, Timely Response.* The first document focused on warning signs and early detection; the second provided guidelines for implementing the *Early Warning/Timely Response* guide. Since the publication of these guides, a plethora of school safety manuals and recommended violence prevention interventions have appeared and can be accessed through such venues as the American Psychological Association and the U.S. Office of School Safety under the Department of Homeland Security.

Schools have now realized that these complex problems cannot be dealt with through a business-as-usual approach. School administrators are searching for and considering an array of strategies that will help make schools safer and more effective; they are now open to prevention approaches in ways that have not heretofore been in evidence (Committee for Children, 2002, 2008; Sprague & Walker, 2010). The spate of tragic school shootings over the past several decades has prompted a strong investment in school security technology by educators and also created pressures for the profiling of potentially dangerous, troubled students. Neither approach has been particularly effective in making schools safer or free of the potential for violence. In addition, profiling has serious downside risks for student victimization through reputational damage (Kingery & Walker, 2002).

Until the early 2000s, school administrators were generally open to, but somewhat less than enthusiastic about investing in comprehensive, positive, behavioral-support approaches that (a) create orderly, disciplined, and healthy school environs; (b) establish positive school cultures; and (c) address the needs of *all* students who populate the school. However, this situation changed dramatically with the emergence of conceptual schemes that adapted the Institute of Medicine's prevention classification (primary, secondary, tertiary) for effective use within school settings (see Walker et al., 1996). This classification system casts prevention efforts in a way that is appealing to educators in terms of cost efficiencies and it is also consistent with the beliefs and values of those charged with educating students.

Scholar-researchers in the fields of school mental health, special education, and school psychology have since developed a series of coordinated, multilevel intervention models based on this adapted prevention scheme (Frey, Lingo, & Nelson, 2010). The best-known and most cost-effective approach in this regard is the Positive Behavior Intervention and Supports (PBIS) systemic intervention developed by Rob Horner, George Sugai, and their associates at the University of Oregon in the early to mid-1990s (Horner et al., 2009; Horner, Sugai, & Horner, 2000). The PBIS model has been broadly disseminated and widely adopted, and was also profiled in *Safeguarding Our Children: An Action Guide for Implementing Early Warning/Timely Response* (see Dwyer & Osher, 2000) as a recommended school safety solution.

Positive Behavior Intervention and Supports (PBIS) is an ecological intervention approach that focuses on the school setting as a system and is based on the foundations of prevention as developed by the Institute of Medicine and U.S. Public Health Service. PBIS promotes three critically important skills (*be safe, be respectful, be responsible*) that are infused into all sectors of a school (i.e., classroom, playground, lunchroom, bus stop) where students assemble. PBIS requires an 80% buy-in from all school staff for the adoption process to proceed. Full PBIS implementation requires approximately two school years. The PBIS systemic approach has proven highly effective as well as highly acceptable to school gatekeepers as indicated by the now 14,000 K–12 schools that have formally adopted the program across the United States. This powerful and transforming innovation is described in more detail later in this chapter. PBIS has revolutionized the way in which EBD students are served by schools and has also reformed general education in the direction of greater efficacy, safety and security, and the provision of needed supports for *all* students who need them.

Behaviorally at-risk children and youth provide a funnel or portal through which the toxic social conditions of our society spill over into the school setting and destructively impact the capacity of our schools and educators to provide the normalizing and protective influences of schooling. This growing student population increasingly pressures and challenges teachers' management and instructional skills and disrupts the teaching-learning process for everyone connected with schooling. The peer cultures of schools grow ever more corrosive, and there are more incidents of challenges to school authority and operational routines by angry, out-of-control students. School personnel, perhaps understandably, regard members of this student population with hostility and suspicion partly because of the intense challenges they present. Further, school staff often hold the mistaken belief that such students deliberately refuse to adopt a more adaptive behavior pattern at school even though they are perceived as fully capable of doing so.

This chapter focuses on the dimension of emotional and behavior disorders (EBD) among behaviorally at-risk students in the context of schooling. The issues and topics considered herein are focused primarily upon student problems of an externalizing, acting out nature that are typically manifested within school settings (Shinn & Walker, 2010). The chapter is written from the perspective of the school-based professionals (school psychologists, special educators, school counselors, early interventionists, behavioral specialists) who are expert in addressing the needs and problems of this behaviorally at-risk student population. We present information on five major topics: (1) brief history and overview of the BD field; (2) the current and projected future status of the BD field; (3) the development of conceptual formulations, assessment tools, and evidence-based strategies and approaches for responding to the adjustment problems and needs of behaviorally at risk students within the school setting; (4) the classification of school related social skills and best practices in teaching them effectively; and (5) creation of an effective prevention agenda for schools regarding the behaviorally at risk student population. The chapter concludes with some brief reflections on the future of the BD field and directions it may wish to consider.

BRIEF HISTORY AND OVERVIEW OF THE BD FIELD

BD professionals working in higher education, agency settings, and school settings are uniquely positioned to collaborate with each other in order to achieve a positive impact on the needs, challenges, and problems presented by the behaviorally at-risk student population. They have intimate knowledge of schools and their cultures; they know instructional processes and routines; and they are experts in behavior change procedures. No other professional combines these types of skills and knowledge. More than any collection of professionals, individuals working within the BD field are well positioned to address the complex needs of this growing student population. The BD field has developed some seminal contributions to our understanding of school-related behavior disorders along with methods for intervening with them, but this knowledge base and these proven practices are often not in evidence in the daily operation of schools. The gap between what is known about evidence-based, effective practices and what is actually practiced is nowhere greater than in the field of school-related behavior disorders. Rogers (1995) has commented at length about the commonly seen lag that exists across disciplines between the development and adoption of innovations. The great challenge for BD professionals is to scale up and make available on a broad basis the effective practices that have been developed over the past two decades.

The field of behavior disorders can trace its roots to the use of behavior change procedures with mentally ill children and youth placed within highly restrictive settings (mental institutions, residential programs) and to the delivery of mental health services for the emotional problems of vulnerable children and youth within school and community settings. Over the past three to four decades, the number and severity of the problems manifested by children and youth, who are described as having emotional disorders (ED) or behavior disorders, have changed in their relative frequency and severity (Evans, Weist, & Serpell, 2007; Walker & Shinn, 2002, 2010; Walker, Zeller, Close, Webber, & Gresham, 1999). Early on in the BD field's history, the children and youth referred and served as emotionally or behaviorally disordered were restricted primarily to those having internalizing type problems that are often directed inwardly (i.e., mental and emotional problems such as depression, anxiety, social withdrawal). Problems representing critical behavioral events, sometimes involving a danger to self and others, such as severe aggression, antisocial behavior, disruptive behavior disorders, vandalism, cruelty to animals, and interpersonal violence, were rarely dealt with in any systematic or treatment sense by BD professionals working in schools. The disciplinary focus of the BD field early in its history was thus quite narrow.

School-related behavior disorders, as a disciplinary subspecialty of general special education, is a relatively new field dating from the early 1960s. In September 2011, the Council for Children with Behavior Disorders, which is the professional advocacy organization representing school-related behavior disorders, will celebrate its 50th anniversary at a conference in New Orleans. In the 50 years since its founding, the BD field has dramatically increased the diversity and breadth of the focus areas it covers. The upcoming conference celebrating its anniversary will include presentations and workshops on a total of 17 topics such as *autism spectrum disorders, bullying, aggression and safe schools, classroom management, dropout prevention, transition from school to work, early intervention, juvenile justice, school-based mental health, social emotional learning, law and legal issues, and alternative education.* The complexity and societal relevance of this listing reflects a remarkable expansion in the capacity of the BD field to successfully deal with very serious problems and challenges affecting the school careers of EBD students and the school systems that accommodate them.

Although encompassing diverse philosophical and theoretical approaches, the BD field has generally maintained a consistent focus on empirical research. It has also provided important journal and monograph outlets for the contributions of its researchers and scholars. The *Behavioral Disorders Journal*, the *CCBD Monograph Series*, the *Journal of Emotional and Behavioral Disorders*, the *Journal of Positive Behavior Support*, the *Journal of School Mental Health*, and *Education and Treatment of Children* are excellent examples of peer-reviewed publications that publish high-quality research and commentary in the BD field. These outlets and their respective editors have advanced the field's development and have contributed substantively to the cohesive knowledge base that we see today relating to the social, emotional, and behavioral status of at-risk children and youth in the contexts of school and community.

Professionals in the field of behavior disorders are charged with effectively accommodating this changed population of children and youth within the context of schooling. The presence, risk status, and intense needs of these students place powerful stressors on the ability of schools to serve them; they present a continuing and significant challenge to BD professionals and to the schooling process generally. For a subset of this student population, schools are now required to forge partnership arrangements with mental health and other social service systems (i.e., child protection) in order to meet the complex needs of these individuals and their families.

For those children who enter the schoolhouse door having severe, tertiary-level involvements, schools will find it necessary to continue forging effective partnership arrangements with nonschool service systems such as mental health. We see this development as a positive one that should be promoted and enhanced. The advent of family resource centers, for example, that are attached to school districts provides an excellent vehicle for the coordination and delivery of such approaches.

Currently, BD professionals at all levels are challenged as they have never been before. Continuing to try and serve students having severe mental health needs primarily under the aegis of the EBD category of special education is not a viable or workable option. The intensity of need and the sheer numbers of affected individuals are simply too great, and the consequences of not serving this growing student population are tragic, cost ineffective, and potentially ominous for the larger community and society. Schools, in collaboration with community agencies, must find new ways of responding to this service need that continues to grow and expand. The BD professional can play an essential role in building a new service delivery infrastructure for meeting this critical need and making sure that schools are key players in developing viable solutions for it. A useful template for developing such a comprehensive system is referenced and briefly described in a later section.

Because of the quality of the BD field's cadre of professionals, its consistently empirical focus, strong commitment to best and preferred practices, and the diversity and rigor of its methodological tools and approaches, the field has a well developed capacity to contribute innovations that can lead (a) to important outcomes in the lives of youth with emotional and behavioral disorders and (b) to the enhancement of the skills and effectiveness of online BD professionals. Many of these contributions can be documented as they operate currently within general education contexts, albeit at much lower than desired levels of practice. Some seminal examples include:

- The roots of many standards-based school reforms and performance-based assessment systems can be traced to behavioral psychology and applied behavior analysis.
- The current emphasis on teaching social skills as part of the regular school curriculum to reduce conflicts and prevent violence results from initiatives by BD and related services professionals.
- The development of highly effective behavior management approaches for managing student behavior in specific school settings results from prototype models developed by the BD field.
- The extent to which parents, early childhood educators, and school personnel rely upon behavioral intervention

programs, designed for children and youth having autism spectrum disorder, as developed by Applied Behavior Analysis professionals.

For much of its history, the BD field has functioned as a parallel service system within schools whose primary role was to accommodate the needs of a narrow subset of the full K–12 student population having serious social-emotional problems. Fortunately, that is no longer the case. In many instances, general educators and BD professionals collaborate in establishing support and intervention systems that allow EBD students to remain in general education settings while having their needs met therein satisfactorily. Often, parents and community agency personnel are involved as key partners in these collaborations.

THE CURRENT AND FUTURE PROJECTED STATUS OF THE BD FIELD

In the past several decades, the BD field has contributed a number of conceptual and empirical advances that have (a) increased our understanding of how behaviorally at-risk children and youth come to engage in and sustain their destructive, maladaptive behavior patterns over time; (b) through observational analysis, documented how some school staff interactions with students having emotional or behavioral disorders in teaching-learning situations control both teacher and student behavior in negative ways; (c) provided for the proactive, universal screening and early identification of school-related, maladaptive behavior patterns that impair school adjustment and achievement; (d) documented the relationship between language deficits and conduct disorder among at-risk children and youth; (e) investigated the metric of disciplinary referrals and contacts with the school's front office as a sensitive measure of such dimensions as the school's climate, the impact of school wide interventions, and the behavioral status of individual students as well as targeted student groups; (f) developed effective, low-cost models of school-based intervention that allow access to needed services and supports for *all* students in a school; (g) contributed school-wide, disciplinary, and positive behavioral support systems that improve outcomes for the whole school; (h) reported longitudinal, comprehensive profiles of the affective, social-behavioral status of certified, referred, and nonreferred students; and (i) developed the concept of resistance to intervention for use in school-based eligibility determination and treatment selection decisions (see Walker et al., 2004). These advances have improved the BD field's ability to meet the challenges and pressures of a changed student population with emotional or behavioral disorders and to address proactively the vulnerability of schools in preventing and responding to the violent acts of disturbed youth such as Kip Kinkle.

In spite of these seminal achievements and contributions, there remains a number of issues, challenges, and barriers that negatively moderate the efficacy of BD professionals working in school settings. The high rate of burnout among BD school staff remains a serious problem in serving this student population. The reluctance of school personnel to proactively screen for and serve the BD student population is driven by the legal mandates associated with special education certification and the vulnerability to lawsuits that are associated with them. The overreliance on assignment of BD students to restrictive settings deprives them of their right to access general education settings with their normalizing benefits. The ambiguities inherent within the federal definition used to define and certify students as EBD serves to hamstring good faith efforts to identify and serve their needs. The stigma of being identified and certified as EBD has a strong social impact among both peers and school staff that is often negative.

The above is but a partial listing of barriers and obstacles that stand in the way of delivering best practices to EBD students who are certified for special education as well as those behaviorally at-risk students who need additional supports and services. It is obvious that the enormous needs of this school population must be served by other less expensive and less politically laden procedures. As a partial response to this concern and as a means of preparing for the reauthorization of federal legislation relating to the BD student population, the U.S. Office of Special Education Programs (OSEP) convened an expert panel of 22 leading BD professionals to provide input as to (a) the current status of the BD field and (b) the desired future status of this field. This group was hosted for 2 days by OSEP and the American Institutes for Research (AIR) in Washington, DC, in October 2010. Attendees were given a gap analysis assignment prior to the conference where they were asked to indicate issues and problems that were currently impacting the BD field and to also indicate the desired future state of affairs. In other words, in the opinion of the panelists, what was working and what needed to be in place for things to work better than they currently are?

Prior to the conference, AIR and OSEP staff analyzed and collated panelists' responses to this task and prioritized them. This analysis also noted commonalities of views across individual panel members and provided a collective snapshot view of their perceived strengths and weaknesses in the BD field. In their initial discussions at the summit, panel members were asked to validate and rank order the issues and problems that emerged from the gap analysis. This exercise identified the following nine high-priority issues and practices needing systematic attention through legislation, policy changes, research and/or personnel development and deployment: (1) need for primary prevention efforts achievable through greater use of universal interventions; (2) improvement in instructional practices with all students; (3) adoption of evidence-based interventions (EBIs) implemented with integrity; (4) investment in universal early screening and identification efforts to enable prevention and intervention; (5) mounting research on practices that "work" effectively within school settings and contexts; (6) develop increased capacity to train personnel who can teach and manage the BD student population effectively; (7) address teacher recruitment, retention, and burnout problems among BD teachers and related staff; (8) greater supports provided in negotiating the difficult transition from school to adult living; and (9) the need for better family supports provided through wraparound and case management services.

These topics were discussed at length and consensus was reached on a final list of eight categories among panel members and OSEP staff. For each of these categories, the panelists were asked as a group to identify current status issues as well as desired future status issues. That is, what is the current state of affairs relating to each category and what should be the desired state of affairs relating to each? Appendix A to this chapter provides a shorthand synopsis of the results of this analysis by prioritized categories. This information will serve the BD field and general education well in terms of providing a roadmap for improving current practices relating to school-related behavior disorders. The consensual recommendations of these expert panelists not only produced a necessary snapshot of the BD field but will also powerfully inform an agenda for moving forward with policy initiatives, legislation, research, and the promotion of best practices. Ultimately, this effort should lead to improvements in the life quality of EBD students, their families and the professionals who serve them. Additional information regarding this panel's outcomes will be forthcoming from the U.S. Office of Special Education Programs and/or AIR.

DEVELOPMENT OF CONCEPTUAL FORMULATIONS, ASSESSMENT TOOLS, AND EVIDENCE-BASED STRATEGIES

In the past several decades, some remarkable progress has been made in more effectively accommodating students who struggle within academic and behavioral performance domains. This progress results from (a) the application of conceptual frameworks that better organize and coordinate the deployment of school resources; (b) the development of procedures that allow for the archival analysis of students' disciplinary records, early universal screening, and new tools for the sensitive assessment and instruction of students' social skills; and (c) the development and adoption of evidence-based interventions and innovations that produce improved student outcomes.

Deployment of School Resources and Improved Teacher Management of Escalated Student Interactions

New conceptual schemes for explaining and organizing school-based problems of students are not uncommon. Some rise to the level of affecting school policies and practices but most do not. However, in the authors' view, there are two such conceptualizations of school-based student behavior and one conceptual model of escalated teacher-student interactions that are especially valuable and that have had a broad-based impact on the practices of school personnel over the past decade and a half.

Adaptation of the Institute of Medicine's Prevention Classification System for Use in School Settings

In 1996, Walker and his colleagues published an article in which they adapted the Institute of Medicine's classification system of prevention types to school settings (see Walker et al., 1996). These types of prevention are *primary, secondary, and tertiary* and refer respectively to (a) preventing the emergence of problems through recommended preventive practices, (b) ameliorating and/or reversing the impact of risk factors that have negatively affected an individual's status or performance, and (c) reducing the impact of severe deficits or problems resulting from long-term exposure to risk factors. In their school adaptation of this framework, Walker et al. (1996) recommended the use of universal classroom and school intervention approaches, to which all students are exposed simultaneously in an identical fashion, to address primary prevention goals and outcomes. At the secondary prevention level, those students (usually 5% to 7% of the student population) who do not respond adequately to the universal intervention are identified and served more intensely within small groups or individually. Tertiary prevention strategies are then applied to a small subset of the remaining students (usually 1% to 2% of the student population) who require more than is available at a secondary prevention level. Often, tertiary students require services and supports that are not available within the school setting (e.g., child protection, drug treatment, family therapy). Figure 17.1 provides a visual schematic or graphic organizer of this conceptual framework.

This adapted conceptual scheme has, since its appearance in the late 1990s, had a major impact in effecting the more cost effective delivery of school-based resources to all students, and especially to those students who struggle to achieve school success. It allows for the efficient deployment of intervention strategies in that all students receive exposure to a classroom wide, universal intervention before it is applied to either small groups or to individual students (i.e., teaching social skills or anti-bullying strategies to the whole class). Failure to respond to the universal intervention satisfactorily is the criterion for moving upwards within this three-tiered system to a more intensive, and expensive, level of intervention. Only those students who fail at Tier 2 move on to tertiary level strategies at Tier 3.

Thus, a more cost-efficient allocation of school intervention resources is achieved by using this framework. In an ecological sense, it is also a much better fit with the core values and demands of educators. It is our experience that school personnel are typically seeking intervention strategies that address important priorities, create more orderly classrooms, fit seamlessly within school routines and operations, solve vexing problems, and do not require extraordinary time and effort for their implementation. The broad based adoption and implementation of interventions based on this framework over the last decade strongly suggest that these goals are more often met than not in this regard (Frey et al., 2010; Horner et al., 2009; Sugai, Horner, & Gresham, 2002). Perhaps more importantly, the adoption of this framework has substantially reduced the legal obstacles associated with BD students being denied access to interventions because their certification under Special Education laws and regulations would pose the risk of lawsuits. This service delivery

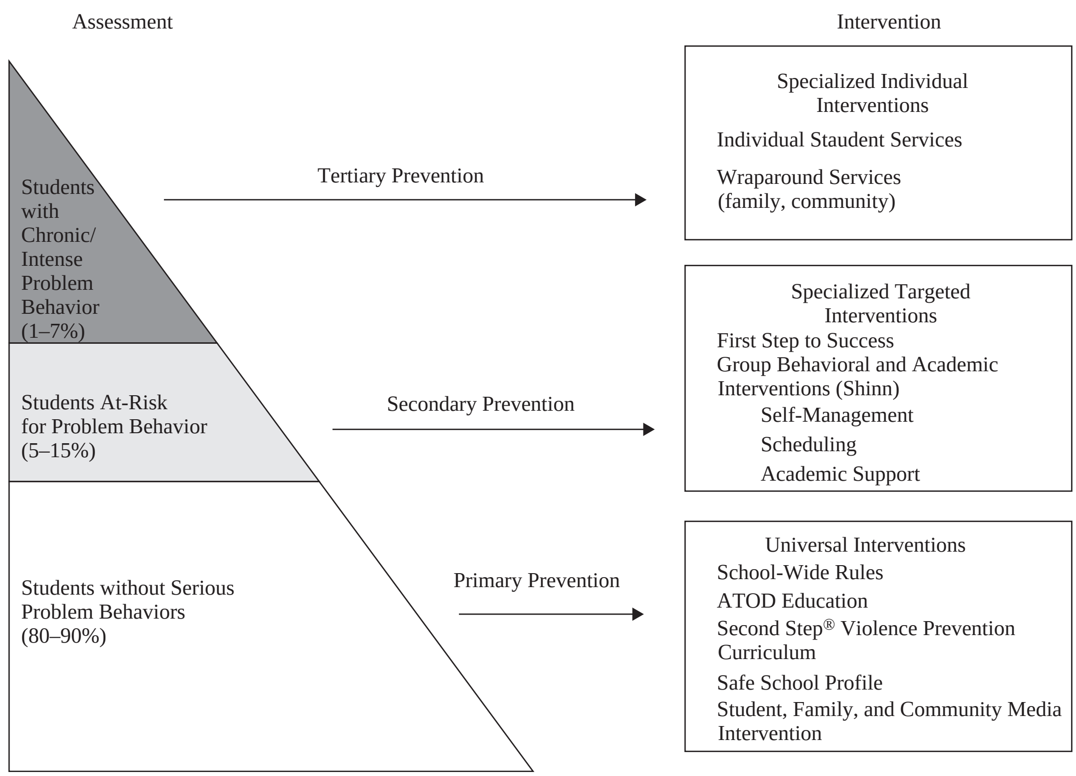


Figure 17.1 Preventing violent and destructive behavior in schools: Integrated systems of interventions

From "Integrated Approaches to Preventing Antisocial Behavior Patterns among School-Aged Children and Youth," by H. M. Walker, R. H. Horner, G. Sugai, M. Bullis, J. R. Sprague, D. Bricker, & M. J. Kaufman, *Journal of Emotional and Behavioral Disorders, 4* (1996), 194–209. Copyright 1996 by SAGE.

model insures that *all* students within a school are eligible to receive needed supports and services excluding those that can only be made available through special education certification (e.g., physical therapy).

The reach and impact of this three-tiered model has been substantial and has extended beyond the school's borders. For example, a number of federal and state agencies that award grants to support educational research and related activities have used this formulation to structure their procurement and grant award practices. In our view, however, its most important outcome has been the reform of thousands of individual schools in ways that are consistent with public demands for greater accountability and effectiveness. This ecological framework generally leads to a more positive school climate, greater support of students, and increased cohesion of administrative and online staff (Frey et al., 2010). And finally, it provides a useful platform for the adoption, implementation, and evaluation of evidence-based practices (Detrich, Keyworth, & States, 2008).

Adoption of a Bipolar, Externalizing-Internalizing Conceptual Scheme for the Universal, Early Screening of Students At Risk for School Related Behavior Disorders

In 1990, the multistage *Systematic Screening for Behavior Disorders* (SSBD) procedure was published (Walker & Severson, 1990). This multiple-gating screening system was based on the externalizing-internalizing classification of Ross (1980) and Achenbach (1991). In the SSBD developers' view, a substantial majority of school related problems that students manifest in the context of schooling can be accounted for and classified under this bipolar dimension. That is, externalizing problems tend to be directed outwardly toward the external social environment and generally involve too much behavior. Externalizing problems in the context of schooling typically consist of such things as antisocial behavior, various forms of aggression, bullying and harassment, disruptive behavior problems, noncompliance with teacher directives, and teacher defiance. Internalizing problems, in contrast, involve too little behavior with problems directed inwardly rather than outwardly; they characteristically are manifested as social withdrawal and avoidance, anxiety, fears, and phobias, and lack of assertive behavior. Both externalizers and internalizers frequently suffer peer rejection but for different reasons.

The SSBD procedure structures and standardizes teacher judgments regarding behaviorally at-risk students across two screening gates and relies on in vivo behavioral observations, recorded in classroom and playground settings, to assess student behavior at screening gate three. Figure 17.2 graphically displays the SSBD multiple gating system. In screening gate one, the general education teacher nominates and rank orders a small subset of students in the class ($N = 5$) whose characteristic behavior pattern(s) most closely match a standardized definition of *externalizing.* Next, the teacher performs this identical task in relation to a standardized definition of *internalizing* and selects another five students whose characteristic behavior most closely resembles the internalizing definition. These two sets of five students each then move to screening gate two where they are rated by their teacher on brief behavioral rating scales (adaptive and maladaptive) that estimate frequency of occurrence along with a critical events checklist that indicates the presence or absence of behavioral events of high intensity (e.g., severe depression, hallucinates, attempts self injury, tries to injure another student). Those students who exceed normative criteria and cutoff scores on these instruments then move on to an optional, screening gate three where they are systematically observed in classroom and playground settings by someone other than the classroom teacher (e.g., school psychologist, school counselor, behavior specialist, early interventionist). Students who exceed normatively derived cutoff scores on the classroom and playground codes are then referred for specialized services, supports and further evaluation by child study teams maintained by the school district.

The externalizing-internalizing classification system incorporated into the SSBD screening system has been instrumental in creating improved practices in schools' identification and treatment of behaviorally at risk students and has also removed much of the idiosyncratic bias of teachers toward the referral of externalizers and internalizers (Severson et al., 2007). The SSBD has been widely adopted by U.S. school districts and is considered the gold standard in the universal, proactive early screening of general education students in order to identify those who are in need of supports and services for their problems. It has also been a much utilized research tool by researchers working with the behaviorally at risk student population.

The above examples are instructive in that they illustrate how conceptualizations of organizations as well as complex forms of human behavior can provide a solid foundation for the deployment of evidence-based intervention approaches within differing school contexts (i.e., Tiers 1, 2, and 3) and also provide for more accurate, less-biased screening approaches that take full advantage

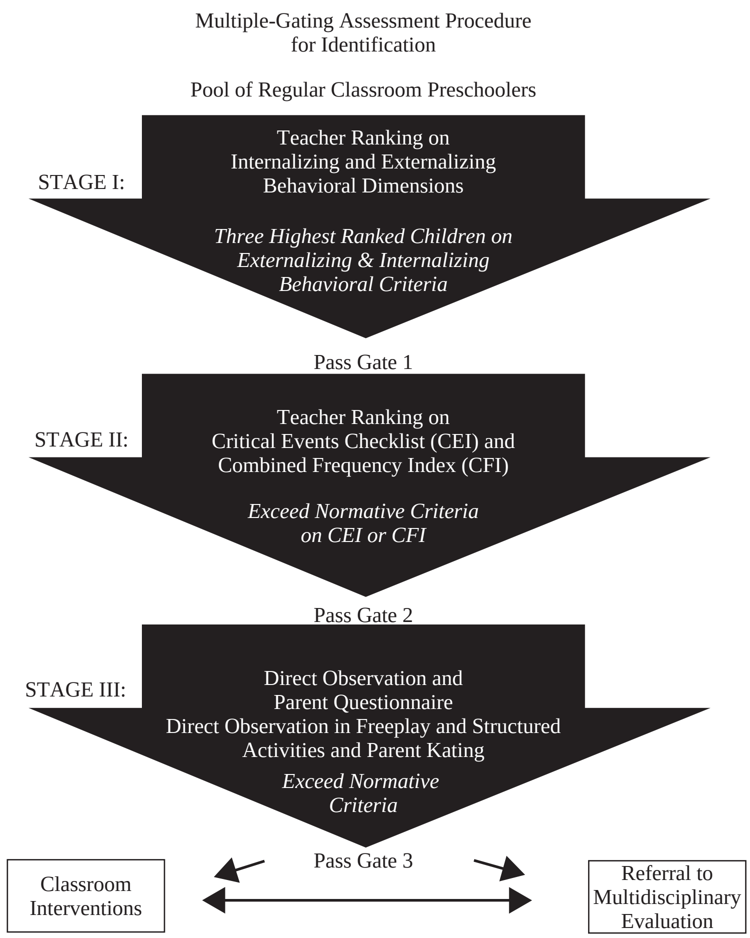


Figure 17.2 Multiple gating process used by the systematic screening of behavior disorders

Adapted from Feil, E., Severson, H., & Walker, H. M. (1994). Early Screening Project: Identifying Preschool Children with Adjustment Problems. *The Oregon Conference Monograph, Volume 6.* Eugene OR: College of Education, University of Oregon.

of what teachers observe and know about the behavioral characteristics of the students they teach and manage. These classification systems are relatively simple but they reduce enormous organizational and individual complexities to manageable levels.

A Conceptual Model Governing the Analysis of and Response(s) to Hostile, Escalated Student-Teacher Interactions

An important line of work has developed in the BD field over the past several decades relating to the often highly destructive interactions that can occur between BD students and their teachers within classroom settings. This work sheds considerable light on the interactive dynamics occurring in these teacher-student exchanges wherein the behavior of each social agent is reciprocally controlled by actions of the other resulting in an escalating spiral of provocations and responses. The student member of this interactive dyad is often angry, highly agitated and used to intimidating adults; the teacher member is typically not trained in how to manage out of control students or in how to prevent and extract oneself from such an escalating process once it begins (Colvin, 2004; Walker, Colvin, & Ramsey, 1995). The resulting effects of these destructive interactions can further damage the teacher-student relationship, disrupt the instructional process, and reduce allocated instructional time for everyone. Worse, subsequent interactions between such students and the teacher are more likely to replicate this destructive pattern.

Colvin (2004, 2009) has developed a conceptual model that captures the phases of behavioral escalation that a teacher and an agitated student typically cycle through in a hostile confrontation. Figure 17.3 illustrates the phases of this model of escalation. It begins with the teacher's making a simple demand of an agitated student (e.g., Do you have your homework? Take out your notebook and turn to page 14) who appears calm but actually is not. The teacher's question or directive serves as a trigger

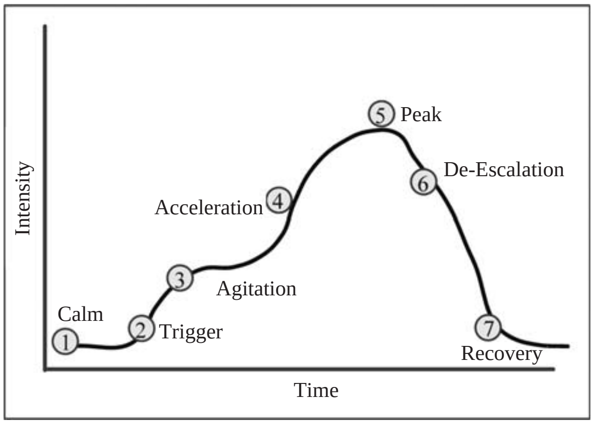


Figure 17.3 Phases of escalating behavior

Colvin, G. (2004). *Managing the cycle of acting-out behavior in the classroom.* Eugene, OR: Behavior Associates.

that accelerates the agitation. This acceleration process typically occurs through a reciprocal question-and-answer exchange between the teacher and the student. There is an overlay of increasing hostility, emotional intensity, and anger during these exchanges until the interaction hits a peak, usually expressed as teacher defiance or a severe tantrum. The apex or peak is followed by a rapid de-escalation and recovery of a calm state by the student. Unfortunately, seething anger is the usual by-product of this type of interaction on the part of both teacher and student. Usually, these hostile interactions play out within a minute or two but their residual effects can last for days, weeks and even months. (Contact IRIS Media at 258 E. 10th Ave., Eugene, OR 97401, 877–343–4747, or info@irised.com for access to these materials on managing escalated interactions involving teacher defiance.)

These escalated interactions are usually modeled for and learned by BD students in the family context as dysfunctional families often use a process of coercion to control the behavior of other family members (Patterson, 1982; Patterson, Reid, & Dishion, 1992). These same types of negative, destructive interactions typically occur between students with challenging behavior patterns and their teachers. Antisocial students also engage their peers in angry, coercive interactions that are similar to those involving the teacher. These episodes resemble behavioral earthquakes that come out of nowhere, do incredible damage, and require long periods for recovery. This behavioral escalation game is one that teachers should not play for two primary reasons: (1) Even if the teacher gets the better of the student in this public exchange, he or she will likely have created an enemy dedicated to revenge; and (2) if the reverse occurs, the teacher's ability to manage and control the classroom will be severely compromised and even damaged. It is best to avoid and escape from such escalated interactions whenever possible. Colvin has explained how to recognize these developing episodes and how to avoid and short-circuit them (see Colvin, 2004, 2009; Walker et al., 1995).

There are three basic rules to consider in order to avoid getting caught up in one of these escalated interactions: (1) do not make demands on or otherwise initiate contact with a student when he or she appears to be agitated; (2) do not allow yourself to become "engaged" through a series of questions and answers initiated by the student; and (3) do not attempt to visibly force the student's hand or establish your dominance in this situation (Walker et al., 2004; Walker & Walker, 1991). It is likely that managing the agitation levels of antisocial EBD, and BD students and having to constantly cope with such interactive dynamics are major factors in the high burnout rate seem among BD teachers in schools.

The conceptual models described above have (a) improved our understanding of processes relating to service delivery in schools, (b) provided a solid conceptual foundation undergirding the procedures involved in the multistage screening and identification of behaviorally at risk students, and (c) allowed teachers to respond more effectively to agitated students who display explosive behavior in an unpredictable fashion. In the absence of these undergirding conceptualizations, that function as drivers of new methods and innovations in serving BD students, it is highly unlikely that the surge in best practices observed over the past decade would have occurred.

Development of Computerized Procedures for the Archival Analysis of Student Disciplinary Records, the Emergence of Brief Behavior Rating Scales Using Change Sensitive Items, and Innovative Methods for the Assessment and Targeting of Social Skills for School Success

The following section reviews some seminal developments in the school related behavior disorders field that have substantively improved the ability of school personnel to (a) evaluate the ecology of a school setting while generating data for better serving student needs using systematic analysis of archival school records (b) provide regular (weekly), change-sensitive teacher assessments of student social skills using brief behavior rating scales that can monitor student progress on a frequent basis, and (c) assess the social skills status of regular and at risk target groups. These innovations have emerged within the past decade and hold the potential to revolutionize how educators monitor and program for the behavioral and social needs of today's students. Brief descriptions of these approaches follow.

Analysis of Office Discipline Referrals as an Evaluation and Program Design Tool

For the past decade and a half, a group of researchers at the University of Oregon have been investigating the metric of school discipline contacts or referrals to the principal's office for student infractions (teacher defiance, aggression, severe disruption, stealing, etc.) that leave an archival imprint in school records and merit more than just classroom-based sanctions (Sugai, Sprague, Horner, & Walker, 2000; Walker, Stieber, Ramsey, & O'Neill, 1993). If recorded systematically, such disciplinary referrals can be used to profile an entire school, small groups of students, and selected individual students within a school.

Walker et al. (1993) found disciplinary referrals to be a powerful variable in discriminating low risk from high-risk antisocial students. Tobin and Sugai (1999) reported that discipline referrals are associated with the following outcomes: (a) identification for special education, (b) assignment to restrictive placements, and (c) later school dropout. Walker and McConnell (1995) found a moderately strong relationship between discipline contacts and later arrests in a longitudinal study of a sample of high-risk boys. Loeber and Farrington (1998) cited research showing a similar relationship of moderate strength between these two variables among antisocial youth.

In addition to profiling a school, selected target groups, and individual students therein, aggregated discipline contacts across school years can be a sensitive measure of the efficacy of school wide interventions that focus on student behavioral outcomes (Sprague, Sugai, Horner, & Walker, 1999). One of the clear advantages of systematically recording and analyzing this variable is that it accumulates as a natural by-product of the schooling process and can be culled unobtrusively from the existing archival student records of most schools. However, we have found that the utility of disciplinary referrals depends on how well they are defined, recorded, stored and analyzed. Schools that have computerized school records are in a much better position to standardize these key elements and utilize this measure well.

The development of the School Wide Information System by Horner and his colleagues is a significant advance in our ability to record and use disciplinary referral data effectively. The SWIS is a web-based information system designed to help school personnel use office referral data to evaluate the school setting and to design school wide and individual student interventions. The primary elements of the SWIS are:

- An efficient system for gathering information.
- A web-based computer application for data entry and report generation.
- A practical process for using information for decision making.

These three elements provide school personnel with the ability to evaluate individual student problem behavior, the behavior of target groups of students, student behavior occurring in specific settings, and behaviors occurring during certain times of the school day. The SWISS generated data-based reports indicate times and/or school locations prone to elicit problem behaviors, and allow teachers and administrators to shape school-wide environments to maximize students' academic and social achievement. Currently, the SWIS is being used in a total of 8,025 U.S. schools broken down into 4,743 elementary, 1,283 middle, 671 high, and 1,328 K–8/12 schools. SWIS is also used in five countries including the United States, Australia, Canada, Iceland, and New Zealand. SWIS has three core applications—one for primary prevention use, one for secondary prevention use and one for tertiary prevention use. Schools can access SWIS under a license agreement with the University of Oregon that includes an annual fee of $250. An expert SWIS facilitator works with school district personnel to set up the program, to troubleshoot problems, and provide technical assistance as needed. Information about the SWIS can be accessed through the following website address: SWIS.org

The SWIS is a valuable innovation that can substantially improve the operation of an individual school through continuous monitoring, precise definition and recording of school infractions, and standardization of the referral process. It is yet another example of an advance contributed by BD professionals that positively impacts schools and the general education system.

The Emergence of Brief Behavior Rating Scales Using Change-Sensitive Items

For several decades, researchers in psychology and education have been seeking assessment instruments (i.e., social skills, adaptive and maladaptive behavior) that are generically sensitive to change attributable to interventions or other identifiable influences. The authors have both been asked on many occasions if we have knowledge of such a scale. Until recently, the answer has been no. However, the second author has recently begun an exciting program of research to achieve this goal.

Tremendous strides have been made over the past 25 years in constructing sensitive assessments of academic performance using Curriculum Based Measurement (CBM) methods as screening and progress monitoring tools. CBM measures timed academic responses (e.g., words read correctly per minute, math problems solved) that are drawn from an existing curriculum, which provide sensitive measures of a student's academic progress. These assessments are brief, easy to implement, and are highly sensitive to academic interventions and strategies. CBM measures are now considered to be among the most highly regarded assessment tools for continuous progress monitoring of student performance. They are now widely used to progress monitor student performance in reading, math, spelling, and written expression within the context of short-term interventions (Deno, 2005; Shinn, 2010).

Unfortunately, the same cannot be said for continuous progress monitoring tools for students' social behavior. Heretofore, there has not been available a "CBM analogue" for dependably measuring students' response(s) to short-term interventions in the area of social skills and problem behavior—two areas of great concern regarding behaviorally at risk students. There is no widely accepted or proven method for how best to monitor the progress of students' social behavior. However, several methods have been proposed as continuous progress monitoring tools for students' social behavior. They include (a) systematic direct observations; (b) direct behavior ratings; and (c) behavior rating scales. Although each of these assessment strategies is well established in regard to certain uses, collectively they suffer drawbacks that limit their utility as change sensitive progress monitoring tools. The following criteria are required for an assessment instrument that can be used effectively for progress monitoring: (a) establishes benchmarks for students' rates of improvement; (b) identifies students who are not responding adequately to an intervention; and (c) allows decision making about continuing, altering or terminating an intervention based on how the student is responding to it.

Behavior-rating scales, completed by knowledgeable teachers, are capable of being modified, adapted, and used as progress monitoring tools *if* they include a subset of items that tap specific behaviors, which are more sensitive to detecting change than are traditional broad-band rating scales. Gresham et al. (2010) recently developed and analyzed the change sensitivity of a well-known, validated and nationally normed social skills rating scale (*Social Skills Rating System,* Gresham & Elliott, 1990). The goal of this work was to develop a general outcome measure (GOM) that provides generic, technically adequate and instructionally relevant information about an individual's social-behavioral performance. Deno, Mirkin, and Chaing (1982) described six characteristics of a GOM as follows: (1) technically adequate in terms of reliability and validity standards; (2) sensitive to changes in behavioral performance; (3) can be administered repeatedly over a short time period (e.g., once or twice a week); (4) reflects general or overall performance; (5) easily administered and does not require a great deal of teacher training; and (6) is not intervention dependent in that it can be used across a range of interventions targeting the construct of interest.

Gresham et al. (2010) used an extant database, collected during a randomized controlled trial, as a vehicle for identifying a small set of change sensitive items from the SSRS, which was used as one of the primary outcome measures in this study. The data set resulted from a 4-year RCT conducted by the first author and his colleagues within the Albuquerque Public Schools. The focus of the intervention trial was the *First Step to Success* early intervention program, which involved 200 student participants enrolled in Grades 1 to 3 general education classrooms (Walker et al., 2009). First Step is a school-and-home early intervention, designed to achieve secondary prevention goals and outcomes, in which behaviorally at-risk students are taught school success skills. The program is coordinated by a behavioral coach and requires 2 to 3 months for completion or full implementation.

A total of 56 items from the SSRS—Teacher Version were used for the change sensitivity analysis (i.e., Which social skills items most powerfully discriminated between intervention and control participants?). Several statistical metrics can be calculated to quantify, rank, and interpret items according to their change sensitivity. Gresham et al. (2010) used four such metrics: (1) odds ratio, (2) standardized mean difference effect size, (3) *t*-tests, and (4) interaction effect derived from a mixed factorial analysis of variance. The application of these metrics reduced the 56-item pool to 12 items having substantial change sensitivity to the First Step intervention. Reliability estimates for the reduced 12-item Brief Behavior Rating scale were .70 for consistency and .71 for stability coefficients over time. These results indicated that the optimal number of items for inclusion in the BBR, when used as a progress-monitoring tool, was a 12-item scale that maintained acceptable psychometric properties. The content of the 12-item scale appears to have reasonable construct representation of key social skills *and* problem behaviors that comprise the social-behavioral performance of most behaviorally at risk students (Walker et al., 2004).

Gresham et al. (2010) recalculated the original SSRS effect size estimates for the randomized control trial of First Step as reported by Walker et al. (2009) using the newly derived BBR scale. The original effect size estimates for the teacher and parent versions of the SSRS full scale were respectively .87 and .54; when recalculated using the 12-item BBR scale, they increased to 1.29 and .90 respectively (a large or robust effect size is considered to be .80 and above). Similarly, for the teacher and parent ratings on the SSRS problem behavior scale, the effect sizes increased from −.73 and −.69 to −.112 and −1.02, respectively.

This is an exciting and potentially valuable line of research as the final product is a brief, change sensitive scale that can be used by both practitioners and researchers to monitor the social-behavioral performance of students in general. Additional research on the generic applicability of this new scale to differing interventions is ongoing.

The Assessment and Targeting of Social Skills for School Success

Social skills that support school success, in both academic and social-emotional domains, have emerged as one of the most important dimensions in accounting for healthy friendships with peers, positive working relationships with teachers, and academic achievement (Gresham, 2010). Professionals who seek to develop more effective schools, reduce the likelihood of violence, support students with mental health problems, and address bullying and peer harassment almost universally target social skills assessment and instruction as a primary approach. In 1990, Gresham and Elliott created a social skills scale that, in the past two decades, has become the gold standard for social skills assessment in schools as well as across a number of community contexts involving professionals from a range of disciplinary specializations. These authors recently revised and expanded this assessment system and tied results of the assessment process to programming for social skills instruction that is without precedent in the educational domain. This revised instrument is recommended as a research tool as well as a best practice in targeting school-based social skills.

Social Skills Improvement System-Rating Scales (SSIS-RS)

The SSIS-RS (Gresham & Elliott, 2008) is a major revision of the *Social Skills Rating System* (Gresham & Elliott, 1990), which has been one of the most widely used measures of children and youths' social behavior in schools across the United States and in a number of foreign countries. During the period 2003 to 2008, the SSRS was used as a measure of social skills in studies published in more than 50 peer-reviewed journals representing the fields of special education, general education, psychiatry, developmental psychology, educational psychology, school psychology, clinical child and adolescent psychology, mental health, and nursing. Within those same years, the authors of 127 published studies and 53 doctoral dissertations (representing 13 countries) reported using the student, teacher, and/or parent forms of the SSRS to measure child and adolescent social skills and problem behaviors (Elliott, 2008). The SSRS has been used in a number of federal research grants funded by the Office of Special Education Programs (OSEP), the Institute of Educational Sciences (IES), national evaluations of the Head Start program, the National Institute of Mental Health (NIMH), and the National Institute of Child Health and Human Development (NICHD). The SSRS has been translated into numerous languages including Spanish, Portuguese, Hindi, Norwegian, Dutch, German, Russian, and Korean (Elliott, 2008).

The SSRS is a broad-band, multirater assessment of students' social behavior that examines teacher-student relations, peer interactions, and academic performance. It is the only social skills rating scale that yields information from three key rating sources: teacher, parent, and student. The SSRS solicits information from these three sources across Grades 3 to 12 and from parents and teachers for children ages 3 to 5 years. Within the social skills domain, the SSRS has five subscales: *Cooperation*, *Assertion*, *Responsibility*, *Empathy*, and *Self-Control*. In the problem behavior domain, the SSRS has three subscales: *Externalizing*, *Internalizing*, and *Hyperactivity*. Within the academic competence domain, the SSRS measures teacher ratings of performance in reading, mathematics, motivation, and overall classroom behavior.

The SSIS-RS (Gresham & Elliott, 2008) was conceptualized to fit within a multi-tiered model of social skills instruction (universal, selected, and indicated). Similar to the SSRS, the SSIS-RS is meant to assist parents, teachers, and students in identifying significant social skills deficits, strengths, and problem behaviors. The SSIS-RS provides a framework for developing interventions for students who are experiencing social skills deficits and concomitant, competing problem behaviors. The SSIS-RS has a number of advantages over the SSRS, including: (a) updated national norms; (b) four additional subscales (communication, engagement, bullying, and autism spectrum disorder); (c) greater overlap in topics covered across raters; (d) Spanish versions of the parent and student forms), (e) scoring and reporting software; and (f) a direct link from item scores to skill-focused interventions.

Direct Linking of Assessment to Intervention

Unlike the SSRS, which was used primarily as an assessment tool, the SSIS-RS is part of a larger, multi-tiered intervention system and directly linked to intervention tools. The SSIS-RS System includes a Performance Screening Guide (PSG), Classwide Intervention Program (CIP), and an Intervention Guide (IG). These are tools to assess, instruct, and monitor progress in a tiered model of instruction. These tools can be used flexibly; that is, the assessments can be used alone or in combination with either or both of the class-wide or small group manualized intervention programs.

The PSG is a criterion-referenced performance measure intended to be used as a universal screener by teachers to assess all students within their classrooms. It focuses on observable behaviors in four skill areas: positive social behaviors, motivation to learn, reading skills, and math skills. With this tool, educators can quickly identify students within their classrooms who are at risk for experiencing behavior and/or academic difficulties.

As a means to proactively teach social skills within the general education setting, the SSIS-RS evidence-based practices start with the Classwide Intervention Program (CIP). The CIP is a scripted general education program that teaches 10 of the most important social skills for school success as rated by teachers and parents. This program is designed to teacher one social skill per week, three times per week, over a period of 10 weeks.

Students not responding adequately to the CIP, as reflected in PSG postintervention ratings, are more comprehensively assessed using the SSIS-RS in order to achieve a more complete understanding of students' specific social skills deficits. After this assessment, students are placed in the SSIS-Intervention Guide (IG) program, which is a Tier 2 or selected intervention program designed for individuals or small groups of students with similar social skills deficits or problems. This program teaches 20 keystone social skills using a manualized program that is designed to take place over 5 to 20 weeks.

The addition of the CIP and IG manualized intervention programs bolster the validity and utility of the SSIS-RS. This is especially true given the ability of the SSIS-RS to assess features commonly associated with autism spectrum disorders (ASD). As rates of students being identified with ASD are rapidly increasing, it is important not only to assess their behavioral characteristics but also to have evidence-based practices available for intervening to increase their prosocial behaviors. The CIP and IG manuals provide a number of lessons meant to directly teach and reinforce prosocial behaviors across the range of student diversity found in today's classrooms. These procedures may be useful for increasing the specific social skills and positive behaviors of ASD students as well.

The Development and Adoption of Evidence-Based Interventions and Innovations That Produce Improved Student Outcomes

Until approximately the middle of the past decade, and following a long-established tradition, school personnel were not strongly motivated to assume ownership and responsibility for solving the behavior problems and disorders of school-age children and youth. At best, it could be said that they initiated procedures to merely "address" as opposed to "solving" the problems and challenges such students present. Rather than investing in proactive, evidence-based interventions to directly teach essential skills and to develop behavioral solutions to these students' problems, schools have long relied mainly on a combination of sanctions (suspensions, expulsions) and assignment of problem students to self-contained settings in attempts at managing the BD student population. The basic strategy has been to punish or isolate students with challenging behavior rather than to solve their problems and respond to their needs. Some educators have referred to these students as the schools' homeless street people, and, in a real sense, they have often been treated as such.

More recently, however, the attitudes of school personnel and the systems they represent have shown signs of positive change in this regard; this change has probably been influenced by pressures generated from the school reform movement, with its demands for greater accountability, and the societal impact of the school-shooting tragedies of the 1990s. Now schools are beginning to embrace the following practices, which have in the past been infrequently adopted: (a) the universal screening of all students to detect those with emerging behavior disorders; (b) investment in primary, secondary, and tertiary forms of prevention; (c) developing proactive rather than reactive responses to child and youth problems in school; and (d) searching for evidence-based interventions and approaches that are proven to work. The school-based BD professional is ideally positioned to serve as a leader and resource person in facilitating this organizational change.

In our view, the problems attendant on serving the full range of K–12 students with behavior disorders do not stem from a lack of available, evidence-based interventions. Rather, it is much more a problem of knowing what works, having the will to implement effective practices with good integrity, and finding the resources necessary to support this effort (Gresham, 2009). A number of reviews of best practices in the areas of school-related behavior disorders, school safety, and violence prevention have been developed that make this information much more widely available to practitioners. These reviews provide a valuable resource for school-based professionals and administrators who often have difficulty in evaluating the efficacy of differing intervention models and approaches—all of which claim to be effective.

The Institute of Education has provided a valuable service for the field of education over the past decade with its investment in the *What Works Clearinghouse* (WWC). The WWC selects promising programs and approaches to be the focus of a practice guide. That is, a diverse group of national experts is assembled to examine the evidence for a particular program or approach and develops (a) actionable recommendations on how to implement the practice effectively, (b) identifies and provides suggested strategies for overcoming obstacles to effective implementation of the practice, and (c) reports on the strength of the evidence supporting the practice. These practice guides are aimed at practitioners and have proved to be very popular; some of the guides, such as *Solving Behavior Problems in Elementary Schools*, receive approximately 30,000 website hits per month. More than a dozen of these practice guides are available and free to download from the WWC website. At present, a practice guide for solving behavior problems at the secondary (middle and high school) level has been developed but has not as yet been released.

Coinciding with this surge in promising and proven school practices has been a strong movement in the fields of psychology, education and school mental health regarding the promotion and adoption of evidence based interventions (EBIs) and practices. Enormous pressures have evolved that encourage the full range of professionals working with youth and adults to adopt and use EBIs that have been validated by credible scientific evidence. EBIs are defined by the: (a) produce an acceptable or expected level of treatment outcome, (b) produces effects that can be successfully replicated by others, and (c) treatment gains are maintained over time and across settings (Walker & Shinn, 2010). Detrich, Keyworth, and States (2008) have been leaders in the EBI movement and have developed a very useful conceptual model governing the

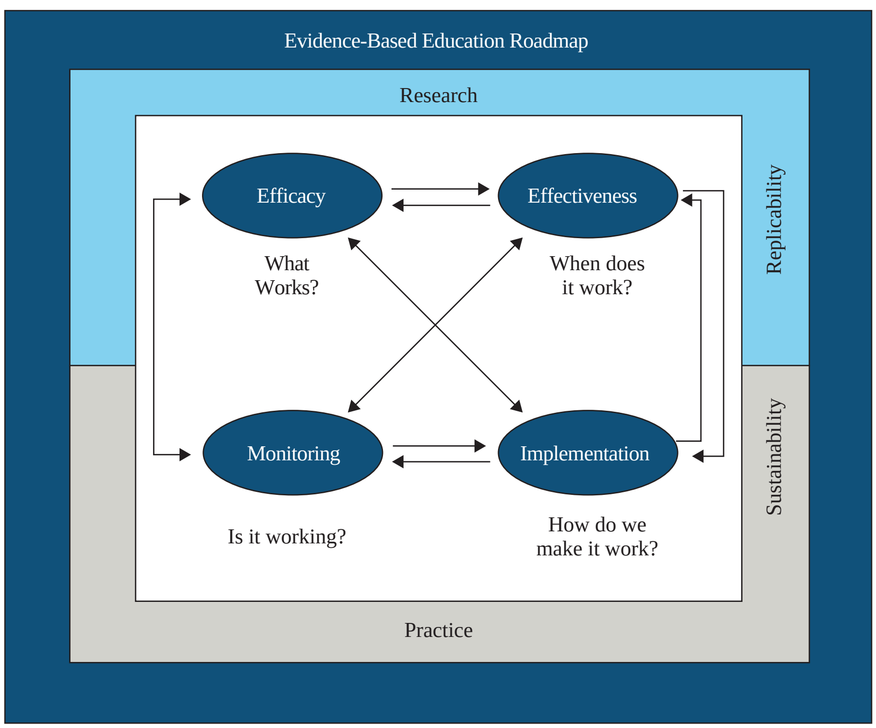


Figure 17.4 Evidence-based education roadmap

From Detrich, R., Keyworth, J., & States, J. (2007). A roadmap to evidence-based education: Building an evidence-based culture. *Journal of Evidence-Based Practices for Schools, 8*(1), p. 30.

application of evidence-based practices within school contexts. Their model has four elements (efficacy, effectiveness, monitoring, and implementation) and it poses a series of critical questions that determine whether and how a particular practice works. Figure 17.4 illustrates this model. Detrich et al. (2008) assign very high priorities to a quality implementation of the practice as well as the use of progress monitoring with sensitive tools (e.g., CBM and BBRs). Their work is highly recommended as a source for those who are seeking to transform school settings and cultures into receptive host environments for promising and proven practices.

The four elements of Figure 17.4 represent "tests" of a practice or intervention that must we addressed and passed at some level in order for it to be considered evidence based. Several evidence-based intervention approaches are profiled below that, in our view, pass these crucial "tests" and serve as exemplars of efficacy in producing improved student outcomes. These are (1) the Positive Behavior Intervention and Support (PBIS) system briefly described earlier, and (2) the Committee for Children's Second Step programs to teach social emotional competence in order to reduce bullying and to prevent school violence. Each of these programs has been carefully developed over many years, is extensively researched, and has generated substantial evidence supporting its efficacy. Each has also gained widespread acceptance among educators and online school personnel.

The Positive Behavior Intervention and Support (PBIS) Program

The development of the PBIS approach is another seminal contribution of the BD field to general education in creating safe and healthy schools where the core values of safety, respect, and responsibility are systematically taught and reinforced by all staff throughout the school setting. The PBIS approach rests upon the conceptual foundation provided by adaptation of the Institute of Medicine's prevention classification to school settings as discussed earlier. PBIS is that rarity of innovations which is both effective and also highly acceptable to school-based practitioners (Frey et al., 2010; Horner et al., 2009). This approach has the advantage of (a) targeting all students within a school; (b) coordinating the three-tiered implementation of universal, selected, and indicated intervention strategies; and (c) focusing on positive, proactive approaches as opposed to punitive, reactive sanctions and interventions.

PBIS is a systems approach to creating and sustaining effective school environs and, as noted earlier, it has now been formally adopted and implemented in over 14,000 schools nationwide. PBIS addresses four target areas of support in order to transform the school setting and to directly teach positive social behavior. These are: (1) social competence and academic achievement, (2) staff behavior, (3) decision making, and (4) student behavior. One of the hallmarks of the efficacy of PBIS is its strong insistence on achieving a high-quality implementation of all its program elements. Office discipline referrals from teachers, using the SWIS system, have been an important outcome measure used to evaluate the school wide impact of PBIS. More recently, the Youth Behavior Self Report Survey, state level achievement tests, and school suspensions have been added as student outcome measures (Bradshaw, Mitchell, & Leaf, 2010).

In one of the earliest evaluation studies of PBIS impact, Taylor-Green and Kartub (2000) found that the number of disciplinary referrals in a largely out of control middle school decreased by 47% in 1 year; after 5 years the initial number of office referrals had been reduced overall by 68% from the preintervention level. A study by Lewis, Sugai, and Colvin (1998) found that this program also reduced problem behavior within specific school settings including the lunchroom, playground, and hallways. Hunter and Chopra (2001) reported a review of primary prevention models for schools in which they endorsed PBIS as a universal intervention that works. Two randomized control trials of the PBIS program have been completed within elementary schools; a middle school RCT is nearing completion and its results will be reported in the near future (see Horner et al., 2009; Bradshaw et al., 2010). Results of this research have been positive and help to establish PBIS as an evidence-based practice. A number of smaller scale studies by differing groups of investigators, using both single subject and group design methods, are ongoing and will further contribute to the PBIS evidence base in the future.

Most significantly, PBIS has been incorporated as a required best practice into reauthorized federal legislation that provides support for students suspected of having a certifiable behavior disorder or disability. Few intervention approaches rise to this level of impact. When used in concert with more specialized intervention approaches that address secondary and tertiary prevention goals, PBIS models have the potential to integrate qualitatively different interventions that will comprehensively impact the behavior problems and disorders of Nearly all students within a school setting (Walker et al., 1996). This is indeed a rare occurrence in the field of general education.

Information about PBIS can be obtained by accessing the following website: PBIS.org

The Second Step Violence Prevention and Bully Prevention Programs

The Committee for Children, located in Seattle, Washington, is a nonprofit group that has been working effectively over two decades to prevent youth violence, bullying, and child abuse. This group's program materials and training methods are superb in terms of their overall quality and they are rarely matched in the field. Their designers are experts in social-emotional learning strategies and their materials focus heavily on the development of key social skills and improvement in the overall social competence of the at risk children and youth populations exposed to them.

The Committee for Children's programs span the age-grade range from preschool through middle school (Grade 8) and they have been implemented in 26 countries to date; it is estimated these programs have involved approximately 9 million children and youth. The signature program of the Committee for Children is *Second Step: Skills for Social and Academic Success,* which is available in two developmentally sequenced versions: grades K through 5 and 6 to 8 (Committee for Children, 2002, 2008, 2002, 2008). Second Step is a curricular program that is taught as subject matter content and is infused into the general education curriculum. The outcomes and impact of Second Step have been well researched by Committee for Children staff and by university and school district based professionals who are experts in child behavior (Cooke et al., 2007; Grossman et al., 1997; Holsen, Iversen, & Smith, 2008; Sprague et al., 2001). Second Step is a highly recommended curricular intervention and no one working with behaviorally at risk students in public schools should be unaware of its existence. School districts can access the Committee for Children Programs and costs via the following website: CommitteeforChildren.Org

The other signature program of the Committee for Children is *Steps to Respect*, which is a bullying prevention program (Committee for Children, 2005). Steps to Respect teaches the core values of caring and respect for others and provides rationales as to why one should not bully or harass others. This program was tested extensively in playground and free play settings during its development (see Frey et al., 2005). It also contains a cyber-bullying prevention module that reduces gossip and negative beliefs about others. Steps to Respect has been included in a number of reviews of anti-bullying programs (Espelage & Swearer, 2010). In our view, Steps to Respect is a bullying prevention approach that should be implemented as a matter of course in elementary and middle schools.

The above programs are exemplars of evidence-based interventions that are based on solid scientific knowledge and that have proven highly acceptable to school personnel over the past several decades. It is indeed rare to find equivalent examples of programs that match PBIS, Second Step, and Steps to Respect on these two important dimensions. The reach of Second Step may be without equal in the history of our field. PBIS has also begun to attract international interest and attention as it has now been adopted in several Scandinavian countries. The most important point to remember in using such programs is that an intervention is only as good as the quality of the implementation with which it is applied—even the best intervention, poorly applied, will produce weak effects (Detrich et al., 2008; Gresham, 2009).

THE CLASSIFICATION OF SCHOOL-RELATED SOCIAL SKILLS AND BEST PRACTICES IN TEACHING SOCIAL SKILLS

When children begin their school careers, they are required to make two critically important social-behavioral adjustments referred to as *teacher-related* and *peer-related* (Walker et al., 1995). That is, they must negotiate a satisfactory adjustment to the academic and behavioral expectations of teachers and conform to the demands of instructional settings. Of equal importance, they must negotiate a satisfactory adjustment to the peer group, find a niche within it, and develop social support networks consisting of friends, affiliates and acquaintances. Walker, Irvin, Noell, and Singer (1992) developed an interpersonal model of social-behavioral competence for school settings. This model identifies the adaptive and maladaptive behavioral correlates of successful student adjustment in the domains of teacher-related and peer-related functioning. The model also describes the long-term outcomes that are commonly associated with the *adaptive* (e.g., school success, friendship making, peer and teacher acceptance) versus *maladaptive* (e.g., school failure and dropout, assignment to restrictive settings, delinquency) pathways contained within it. Figure 17.5 graphically displays this model.

The adaptive and maladaptive behavioral correlates included in the teacher- and peer-related adjustment dimensions of this model are based on research outcomes presented in the professional literature on social

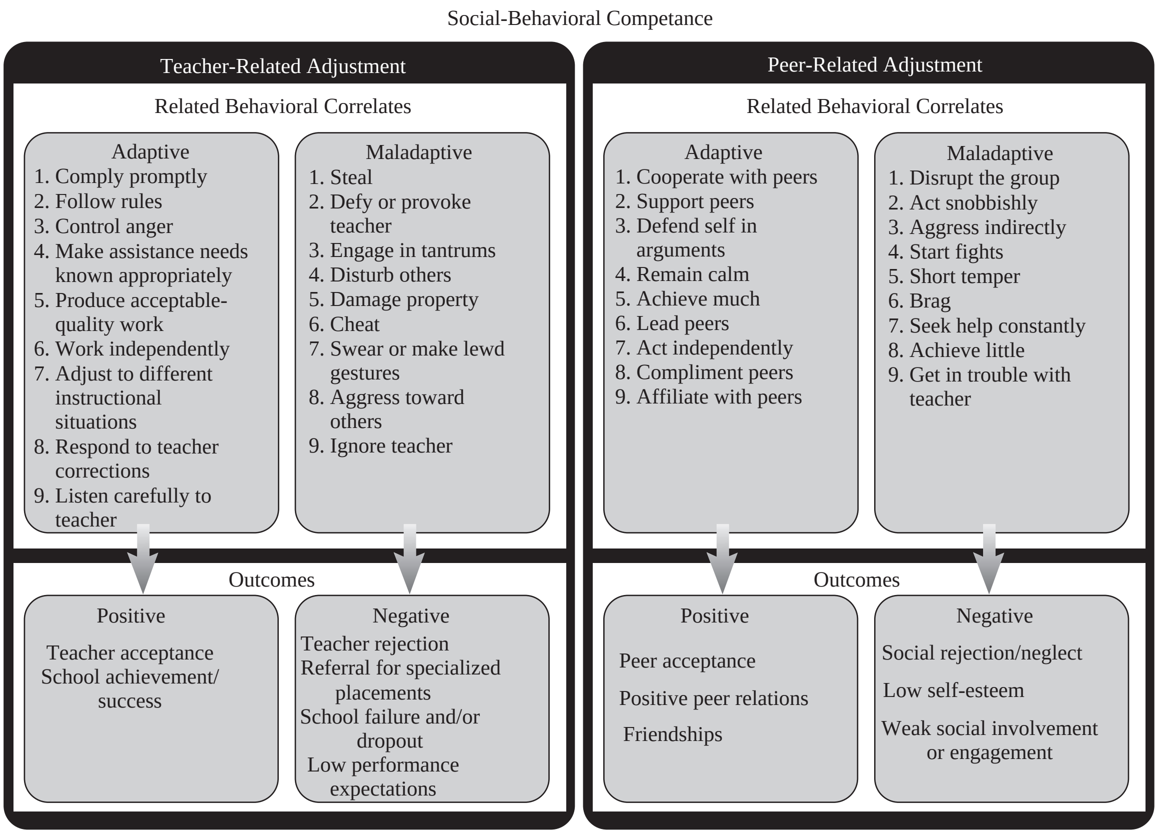


Figure 17.5 Model of interpersonal social-behavioral competencies within school settings

From "A Construct Score Approach to the Assessment of Social Competence: Rational, Technological Considerations, and Anticipated Outcomes," by H. M. Walker, L. K. Irwin, J. Noell, & G. H. S. Singer, in *Behavior Modification, 16* (1992), 448–474. Copyright 1992 by SAGE.

competence (Gresham, 2010; Walker, Ramsey, & Gresham, 2004). The long-term outcomes listed for each pathway under these two forms of adjustment are based on longitudinal and cross-sectional studies reported in the literature over the past two decades (Loeber & Farrington, 1998; Patterson et al., 1992; Reid, Patterson, & Snyder, 2002).

Failure in either of these critically important domains impairs a student's school adjustment and success; failure in both puts a student's overall quality of life at risk and is a harbinger of future problems of potentially severe magnitude. Students with behavior disorders are invariably below normative levels and expectations on the adaptive behavioral correlates of teacher- and peer-related adjustment and usually outside the normative range on the maladaptive behavioral correlates. In the great majority of cases, the intervention of choice for students with behavior disorders involves developing their social skills and overall social competence while teaching them alternatives to the maladaptive forms of behavior that tend to dominate their behavioral repertoires. While considerable progress has been made in the past decade relating to the direct teaching of important social skills (Gresham & Elliott, 2008), we believe the potential of social skills instruction (SSI) for students in general, and particularly for students with behavior disorders, has yet to be fully realized (Gresham, 2010; Walker et al., 2004).

Guidelines for Social Skills Instruction for Students With Behavior Disorders in the Context of Schooling

The school is an ideal setting for teaching social skills because of its accessibility to children and their peers, teachers, and parents. Fundamentally, social skills intervention can take place in school and home settings, both informally and formally, using selected intervention procedures that may have to be individually tailored. Informal social skills interventions are based on the notion of incidental learning, which takes advantage of naturally occurring behavioral incidents or events to teach appropriate social behavior. Most of the SSI in home, in nonclassroom school contexts, and community settings can be characterized as informal or incidental. Literally thousands of behavioral incidents occur in these naturalistic home, school, and community settings, creating rich opportunities for making each of these behavioral incidents a potentially successful learning experience. Formal SSI, on the other hand, can take place seamlessly within a classroom setting in which (a) the social skills curriculum is taught to the entire class or it is taught to selected students within small-group formats and (b) social skills are taught as subject matter content in the same way as are social science, history, biology, and other academic subjects. However, unless formal and informal methods of teaching social skills are combined with each other, there is likely to be a disconnect between conceptual mastery of social skills and their demonstration and application within natural settings.

Objectives of Social Skills Instruction

SSI has four primary objectives: (1) promoting skill acquisition, (2) enhancing skill performance, (3) reducing or eliminating competing problem behaviors, and (4) facilitating generalization and maintenance of social skills. Most students with behavior disorders will likely have some combination of acquisition and performance deficits, some of which may be accompanied by competing problem behaviors. Any given student may need some combination of acquisition, performance, and behavior-reduction strategies. All students will require procedures to facilitate generalization and maintenance of previously learned social skills (see Gresham, 2002, 2010).

Table 17.1 lists specific social skills and behavior-reduction strategies for each of the four goals of SSI. Appropriate intervention strategies should be matched with the particular deficits or competing problem behaviors that the student exhibits. A common misconception is that one seeks to facilitate generalization and maintenance *after* implementing procedures for the acquisition and performance of social skills. The evidence is strong that the best and preferred practice is to incorporate generalization strategies from the beginning of any SSI program (see reviews and commentary by Gresham, 1998, 2002, 2010).

Promoting Skills Acquisition

Procedures designed to promote skill acquisition are applicable when students do not have a particular social skill in their repertoire, when they do not know a particular step in the performance of a behavioral sequence, or when their execution of the skill is awkward or ineffective (i.e., a fluency deficit). A relatively small percentage

TABLE 17.1 Objectives and Strategies of Social Skills Instruction

I. Promoting Skills Acquisition
- A. Modeling.
- B. Coaching.
- C. Behavioral rehearsal.

II. Enhancing Skills Performance
- A. Manipulation of antecedents.
  1. Peer initiation strategies.
  2. Proactive classroom management strategies.
  3. Peer tutoring.
  4. Incidental teaching.
- B. Manipulation of consequences.
  1. Contingency contracting.
  2. Group-oriented contingency systems.
  3. School-home notes.
  4. Verbal praise.
  5. Activity reinforcers.
  6. Token and point systems.

III. Removing Competing Problem Behaviors
- A. Differential reinforcement.
  1. Differential reinforcement of other behavior (DRO).
  2. Differential reinforcement of low rates of behavior (DRL).
  3. Differential reinforcement of incompatible behaviors (DRI).
- B. Overcorrection.
  1. Restitution.
  2. Positive practice.
- C. Time-out.
  1. Nonexclusionary (contingent observation).
  2. Exclusionary.
- D. Systematic desensitization (for anxiety-based competing behaviors).
- E. Flooding and exposure (for anxiety-based competing behaviors).

IV. Facilitating Generalization
- A. Topographical generalization.
  1. Training diversely.
  2. Exploiting functional contingencies.
  3. Incorporating functional mediators.
- B. Functional generalization.
  1. Identify strong competing stimuli in specific situations.
  2. Identify strong competing problem behaviors in specific situations.
  3. Identify functionally equivalent socially skilled behaviors.
  4. Increase reliability and efficiency of social skilled behaviors (build fluency).
  5. Decrease reliability and efficiency of competing problem behaviors.

Source: Lane, K., Gresham, F. M., & O'Shaughnessy, T. (2002). *Interventions for children with or at risk for emotional and behavioral disorders.* Boston, MA: Allyn & Bacon.

of students would need social skills intervention based on acquisition deficits; far more students have performance deficits.

Three procedures represent pathways to remediating deficits in social skill acquisition: *modeling, coaching,* and *behavioral rehearsal.* Social problem solving is another pathway, but it is not discussed herein because of space limitations and because it incorporates a combination of modeling, coaching, and behavioral rehearsal. More specific information on social problem solving interventions can be found in Elias and Clabby (1992).

Modeling is the process of learning a behavior by observing another person performing it. Modeling instruction presents the entire sequence of behaviors involved in a particular social skill and teaches the student how to integrate specific behaviors into a composite behavior pattern. Modeling is one of the most effective and efficient ways of teaching social behavior (Elliott & Gresham, 1992; Schneider, 1992).

Coaching is the use of verbal instruction to teach social skills. Unlike modeling, which emphasizes visual displays of social skills, coaching utilizes a student's receptive language skills. Coaching is accomplished in three fundamental steps: (1) presenting social concepts or rules, (2) providing opportunities for practice or rehearsal, and (3) providing specific informational feedback on the quality of behavioral performances.

Behavioral rehearsal refers to practicing a newly learned behavior in a structured, protective situation of role-playing. In this way, students can enhance their proficiency in using social skills without experiencing adverse consequences. Behavioral rehearsal can be covert, verbal, or overt. Covert rehearsal involves students' imagining certain social interactions (e.g., being teased by another student or group of students). Verbal rehearsal involves students' verbalizing the specific behaviors that they would exhibit in a social situation. Overt rehearsal is the actual role-playing of a specific social interaction.

Enhancing Skills Performance

Most social skills interventions involve procedures that increase the frequency of particular prosocial behaviors in specific social situations because most social skills difficulties involve performance deficits rather than acquisition deficits. This suggests that social skills interventions for most students should take place in naturalistic environments (e.g., classrooms, playgrounds) rather than in small, pull-out-group situations. Failure to perform certain social skills in specific situations results from two fundamental factors: (1) inappropriately arranged antecedents and (2) inappropriately arranged consequences. A number of specific procedures can be classified under the broad rubric of antecedent and consequent strategies.

Interventions based on antecedent control assume that the environment does not set the occasion for performance of social skills. That is, cues, prompts, or other events either are not present or are insufficiently salient in order for the child to discriminate these stimuli in relation to the expected performance of the target behavior(s). A cuing and prompting procedure uses verbal and nonverbal cues or prompts to facilitate prosocial behavior. Simple prompts or cues for some children may be all that is needed to signal them to engage in socially appropriate behavior (e.g., "Say thank you," "Ask Katrina to join your group"). Cuing and prompting represent one of the easiest and most efficient social skills intervention strategies (Elliott & Gresham, 1992; Walker et al., 1995).

Interventions based on consequent control can be classified into three broad categories: (1) reinforcement-based strategies, (2) behavioral contracts, and (3) school-home notes. Reinforcement-based strategies assume that the student knows how to perform a social skill but is not doing so because of limited or no reinforcement for the behavior. The objective in using these strategies is to increase the frequency of reinforcement for prosocial behavior. Reinforcement strategies include attention, social praise, tokens and points, and activity reinforcers as well as group-oriented contingency systems. Extensive discussions of behavioral contracts, school-home notes, and group-oriented contingency systems can be found in more comprehensive treatments of these subjects (Kelley, 1990).

Removing or Eliminating Competing Problem Behaviors

The focus of SSI is clearly on developing and refining prosocial behaviors. However, the failure of some students to either acquire or perform certain social skills may be due to the presence of competing problem behaviors. This is particularly true of students having behavior disorders whose externalizing or internalizing symptoms compete with or block the acquisition and performance of more appropriate behavior(s). For example, aggressive behavior may be performed instead of an appropriate behavior because it may be more efficient and reliable in achieving one's social goals and producing reinforcement. A number of techniques that are effective in reducing competing problem behaviors are presented in Table 17.1.

Facilitating Generalization and Maintenance

Basically, there are only two processes that are essential to all behavioral interventions: discrimination and generalization (Stokes, 1992). Discrimination occurs within the context of stimulus control. A major problem confronting social skills interventions is that it is easier to prompt the occurrence of some behaviors in one place, for a limited period of time, than it is to get those same behaviors to occur in a variety of other places for an extended period of time. That is, it is infinitely easier to teach discriminations than it is to teach generalization and maintenance.

Generalization of behavior change is related directly to the principle of resistance to intervention. If social skill deficits occur at low frequencies, competing problem-behavior excesses will likely occur at high frequencies, and both of these deficits and excesses tend to be chronic with students with behavior disorders (i.e., they have lasted a relatively long period of time), and they will tend to show less generalization across different non training conditions as well as less durability over time as SSI is withdrawn (Gresham, 1991). In effect, these students quickly discriminate training from nontraining conditions, particularly when the training conditions are noticeably different.

Students with behavior disorders often show initial behavior change in response to well-designed and implemented school interventions of a secondary or tertiary prevention nature, particularly in relation to their competing problem behavior excesses, but they tend not to show generalization or maintenance of these behavior changes. One reason for this may be that exclusive attention often is focused on decreasing the momentum of undesirable behavior to the exclusion of facilitating the momentum of desirable behaviors such as critically important social skills. The primary reason for this frequently observed lack of generalization and maintenance is that essential components of behavior change are not actively programmed to occur as part of SSI.

Various generalization programming strategies are presented in Table 17.1 under the headings of topographical and functional generalization. The topographical description of generalization refers to the occurrence of relevant behaviors (e.g., social skills) under different nontraining conditions (Stokes & Osnes, 1989). These nontraining conditions can be settings or situations (setting generalization), behaviors (response generalization), or time-based (maintenance). A more detailed and now-classic treatment of topographical generalization is described by Stokes and Osnes (1989).

A functional approach to generalization consists of two types: (1) *stimulus generalization*, which is the occurrence of the same behavior under variations of the original training conditions (the greater the difference between training conditions and subsequent environmental conditions, the less the generalization), and (2) *response generalization*, which is the control of multiple behaviors by the same stimulus. An extremely important goal of SSI is to determine the reliability and efficiency of competing problem behaviors relative to socially skilled alternative behaviors. Competing problem behaviors will be performed instead of appropriate behaviors if the competing behaviors are more efficient and reliable than the desired target behavior. Efficient behaviors are easier to perform in terms of response effort and produce reinforcement more rapidly. Reliable behaviors are those that produce the desired outcomes more frequently than do the target behaviors of interest. For example, pushing into the lunch line may be more efficient and reliable than politely asking to cut into line.

School personnel should decrease the efficiency and reliability of competing inappropriate behaviors and increase the efficiency and reliability of adaptive forms of behavior in order to successfully program for generalization. The former can be accomplished by many of the procedures listed in Table 17.1 under *Removing Competing Problem Behaviors*. The latter can be achieved by spending more time and effort in building fluency of trained social skills using combinations of modeling, coaching, and, most important, behavioral rehearsal with specific performance feedback (see Gresham, 2002).

We are convinced that SSI outcomes can be greatly enhanced by adopting these best-practice principles and strategies. They have been incorporated into a number of proven behavioral interventions to date (Evans et al., 2007; Gresham & Elliott, 2008; Shinn & Walker, 2010; Shinn, Walker, & Stoner, 2002; Walker et al., 1995; Walker et al., 2004). It has been said that behavior change is a two stage process requiring first a set of procedures to produce it and second a set of procedures to sustain and generalize it (Walker, Colvin, & Ramsey, 1995). We think this observation has the ring of truth! The point is not to assume automatic generalization of intervention effects but instead to plan and program for them.

CREATING A PREVENTION AGENDA FOR SCHOOLS

Because BD professionals are primarily school based, they can have their greatest impact from kindergarten through the primary and intermediate grades. However, many behavioral specialists employed by school districts have the opportunity to work collaboratively with early childhood educators and Head Start personnel who deal with 3- and 4-year-olds. Larger and larger numbers of children are now coming to school lacking in specific school-readiness skills and who are ill prepared to cope with the normal demands and routines of schooling. Getting off to a poor start in one's schooling career can be a serious risk for later school failure, school dropout, and exposure to a host of destructive outcomes (Reid et al., 2002; Walker et al., 2004).

It is essential that BD professionals assume a more active leadership role in making sure that *all* behaviorally at-risk children are detected at the point of school entry and provided with the supports, services, and interventions that will help ensure a successful beginning to their school careers. Achieving this goal will require developing close working relationships with early childhood educators, parents, and mental health professionals, as appropriate. The school-based BD professional is ideally positioned to coordinate the proactive screening and intervention delivery strategies that can divert many behaviorally at-risk students from this path. More specifically, we believe the BD professional's role should include the following four functions—at a minimum:

1. Promulgating best practices for students both with and without behavior disorders that are research based and cost efficient.
2. Advocating for educators' adoption of proven evidence-based approaches to intervention.
3. Forming true partnerships with general educators and professionals from other disciplines that create the commitment and breadth of knowledge necessary to address the complex needs and problems of the behaviorally at-risk school population.
4. Taking the lead in building multidisciplinary, interagency team approaches to providing integrated interventions for at-risk students and their families.

The Perry Preschool Program is an outstanding example of the long-term benefits of systematic early intervention for at-risk children and their families (Barnett, 1985).

Doll and her colleagues have recently contributed a compendium of conceptualizations, frameworks, best practices and evidence-based program models that provide a useful template for development of such a prevention agenda (Doll, Pfohl, & Yoon, 2010). The material in this excellent volume is especially amenable for use by school personnel working within mental health and related services areas.

School personnel are usually receptive to universal intervention approaches primarily because they achieve valued outcomes while treating all students equitably and in essentially the same manner. Thus, the fairness issue that resonates so strongly with most teachers regarding secondary and tertiary interventions is attenuated somewhat as *every* student in the classroom is exposed to the intervention in the same fashion. Those students for whom the universal intervention is insufficient are then exposed to more intensive secondary or tertiary intervention approaches. One of the great advantages of a universal intervention is that it creates a context in which more intensive small-group and individually tailored interventions can achieve greater effectiveness. However, these more costly and intrusive interventions are applied *only* after the failure of a universal intervention approach for certain students. Another advantage is that a universal intervention addresses the problems of mildly involved, at-risk students in a cost effective manner. The scaled-up adoption of this integrated delivery system, when combined with proven intervention models that have been adapted to and tested within the school setting, has the potential to substantially improve schooling outcomes and to create much more positive school climates.

The Center for Mental Health Promotion and Youth Violence Prevention has recently published a comprehensive roadmap for prevention in schools titled: *Realizing the Promise of the Whole-School Approach to Children's Mental Health: A Practical Guide for Schools*. This document is a joint publication of the U.S. Departments of Education, Justice and Health and Human Services and it is must-read for school districts that are contemplating the creation of an effective agenda for preventing youth violence, responding to the needs of at-risk students, and making schools more effective and safe. It addresses the full range of issues, procedures, processes and obstacles that are often encountered in implementing universal school-based approaches. The guide can be viewed and accessed at www.promoteprevent.org/webfm_send/2102

CONCLUSION

The BD field has a talented and knowledgeable cadre of professionals who, in our estimation, could perform well the role of delivering, coordinating and trouble-shooting evidence-based intervention approaches. Traditionally, they have not been adequately supported by school systems in performing these functions. However, with the rapid spread of PBIS type approaches, more and more school districts are now willing to create and support these positions. Literally hundreds of school districts, for example, have appointed professionals to positions that support the implementation of PBIS. It is likely that the recognized cost-effectiveness of these universal approaches has been persuasive as well in this regard.

It has been our intention herein to characterize the current state of the field of school related behavior disorders, to describe the progress that the field has made during the past decade, and to demonstrate its value as a resource to general education in accommodating behaviorally at risk students. Throughout the chapter we have made the case (a) that proven and promising, evidence-based interventions are now available that are designed for and have been tested successfully with students having behavior disorders in a range of school settings; (b) that the BD professional is ideally positioned to assume a leadership role in coordinating these interventions while involving key social agents in the lives of students with behavior disorders (i.e., their parents, teachers, peers); and (c) that this individual, as a rule, has the knowledge, expertise, and necessary role position to work effectively with other agencies and professionals in developing prevention initiatives. We have also described and illustrated herein some evidence-based programs and practices that we think are exemplars of state of the art innovation and efficacy in the BD field.

The BD summit that occurred in fall 2010 is a unique event in the history of our field. The authors are proud to have been participants in this important conference. As noted earlier, the deliberations and decision making of this group of experts will inform the future policy, research and personnel development agendas of the U.S. Office of Special Education Programs for some time to come. The list of topical areas identified as high priorities in this effort (e.g., better family support, more effective instruction, assisting EBD students with the transition from school to adult living, early screening to allow prevention initiatives, evidence-based interventions that teacher critical social skills and positive social behavior and so forth) will provide a long term roadmap for both the BD field and general education. The results of this summit reflect the numerous contributions of BD professionals working in today's schools and provide a valuable roadmap for directing our future efforts.

We are optimistic that these efforts will result in enhancements of schools' capacities to serve BD students and their families better. We look forward to participation in the achievement of this agenda for the BD field.

REFERENCES

Achenbach, T. (1991). *Manual for the child behavior checklist/4–18 and the 1991 profile*. Burlington: University of Vermont, Department of Psychiatry.

American Psychological Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Angold, A. (2000, December). *Preadolescent screening and data analysis.* Paper presented to the 2nd Annual Expert Panel Meeting on Preadolescent Screening Procedures, Washington, DC.

Barnett, W. S. (1985). The Perry preschool program and its longterm effects: A benefit-cost analysis. *High/Scope Early Childhood Policy Papers* (No. 2). Ypsilanti, MI: High/Scope.

Biglan, A. (2001). *The Palo Alto project*. Unpublished document. Eugene, OR: Oregon Research Institute.

Bradshaw, C., Mitchell, M., & Leaf, P. (2010). Examining the effects of schoolwide positive behavioral interventions and supports on student outcomes. *Journal of Positive Behavior Interventions, 12*, 3, 133–148.

Burns, B., & Hoagwood, K. (2002). *Community treatment for youth: Evidence-based interventions for severe emotional and behavioral disorders* (pp. 1–15). New York, NY: Oxford University Press.

Committee for Children. (2002, 2008). *Second step violence prevention curriculum*. Seattle, WA: Author.

Committee for Children. (2005). *Steps to respect: A bullying prevention program.* Seattle, WA: Author.

Colvin, G. (2004). *Managing the cycle of acting out behavior in the classroom.* Eugene, OR: IRIS Media.

Colvin, G. (2009). *Managing noncompliance and defiance in the classroom,* Eugene, OR: IRIS Media.

Cooke, M., Ford, J., Levine, J., Bourke, C., Newell, L., & Lapidus, G. (2007). The effects of city-wide implementation of "Second Step" on elementary students' prosocial and aggressive behaviors. *The Journal of Primary Prevention, 28* (2), 93–115.

Deno, S. (2005). Problem-solving assessment. In R. Brown-Chidsey (Ed.), *Assessment for intervention: A problem-solving approach* (pp. 10–40). New York, NY: Guilford Press.

Deno, S., Mirkin, P., & Chiang, B. (1982). Identifying valid measures of reading. *Exceptional Children, 49*, 36–45.

Detrich, R., Keyworth, R., & States, J. (2008). A roadmap to evidence-based education: Building an evidence-based culture. In R. Detrich, R. Keyworth, & J. States (Eds.), *Advances in evidence-based education* (pp. 3–18). Oakland, CA: The Wing Institute.

Doll, E., Pfohl, W., & Yoon, J. (2010). *Handbook of youth prevention science.* New York, NY: Routledge.

Dwyer, K., & Osher, D. (2000). *Safeguarding our children: An action guide.* Washington, DC: U.S. Departments of Education and Justice, American Institutes for Research.

Elias, M. J., & Clabby, J. F. (1992). Building social problem-solving skills: Guidelines from a school-based program. San Francisco, CA: Jossey-Bass.

Elliott, S. (2008, February). *Two decades of social skills research with the SSRS.* Paper presented at the annual convention of the National Association of School Psychologists. New Orleans, LA.

Elliott, S. N., & Gresham, F. M. (1992). *Social skills intervention guide.* Circle Pines, MN: American Guidance Service.

Evans, S., Weist, M., & Serpell, Z. (2007). *Advances in school-based mental health interventions: Best practices and program models*. New York, NY: Civic Research Institute.

Espelage, D., & Swearer, S. (2003). Research on school bullying and victimization: What have we learned and where do we need to go? In S. M. Swearer & D. Espelage (Eds.), *Bullying prevention and intervention: Integrating research and evaluation findings* (Special Issue). *School Psychology Review, 32,* 365–383.

Espelage, D., & Swearer, S. (2010). Bullying and peer harassment. In M. Shinn & H. Walker, (Eds.) *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 729–738). Bethesda, MD: National Association of School Psychologists.

Frey, A., Lingo, A., & Nelson, M. (2010). Implementing positive behavior support in elementary schools. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 397–434). Bethesda, MD: National Association of School Psychologists.

Frey, K., Hirschstein, M., Snell, J., Edstrom, L., MacKenzie, E., & Broderick, C. (2005). Reducing playground bullying and supporting beliefs: An experimental trial of the steps to respect program. *Developmental Psychology, 41*, 3, 479–491.

Gresham, F. M. (1991). Conceptualizing behavior disorders in terms of resistance to intervention. *School Psychology Review, 20*, 23–36.

Gresham, F. M. (1998). Social skills training: Should we raze, remodel, or rebuild? *Behavioral Disorders, 24*(1), 19–25.

Gresham, F. M., (2002). Social skills assessment and instruction for students with emotional and behavioral disorders. In K. Lane, F. Gresham, & T. O'Shaughnessy (Eds.), *Children with or at risk for emotional and behavioral disorders* (pp. 242–257). Boston, MA: Allyn & Bacon.

Gresham, F. M., (2009). Evolution of the treatment integrity concept: Current status and future directions. *School Psychology Review, 38*, 4, 533–540.

Gresham, F. M. (2010). Evidence-based social skills interventions: Empirical foundations for instructional approaches. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 337–362). Bethesda, MD: National Association of School Psychologists.

Gresham, F. M., Cook, C., Collins, T., Dart, E., Rasetshwane, K., Truelson, E., & Grant, S. (2010). Developing a change-sensitive brief behavior rating scale as a progress monitoring tool for social behavior: An example using the *social skills rating system-teacher form*. *School Psychology Quarterly, 26*, 27–44.

Gresham, F. M., & Elliott, S. (1990). *The social skills rating system (SSRS)*. Bloomington, MN: Pearson Assessments.

Gresham, F. M., & Elliott, S. (2008). *Social skills improvement system-rating scales*. Minneapolis, MN: Pearson.

Gresham, F. M., Lane, K. L., & Lambros, K. M. (2000). Comorbidity of conduct problems and ADHD: Identification of "fledging psychopaths." *Journal of Emotional and Behavioral Disorders, 8*(2), 83–93.

Grossman, D., Neckerman, H., Koepsell, T., Liu, P., Asher, K., Beland, K., & Rivara, F. (1997). Effectiveness of a violence prevention curriculum among children in elementary school: A randomized controlled trial. *Journal of the American Medical Association, 277*(20), 1605–1611.

Hoagwood, K., & Erwin, H. (1997). Effectiveness of school-based mental health services for children: A 10-year research review. *Journal of Child and Family Studies, 6*(4), 435–451.

Holsen, I., Iversen, A., & Smith, B. (2008). Outcomes of the social competence program SECOND STEP in Norweigan elementary schools. *School Psychology International, 29*(1), 71–88.

Horner, R., Sugai, G., & Horner, H. (2000). A school-wide approach to student discipline. *School Administrator, 57*, 20–23.

Horner, R., Sugai, G., Smolkowski, K., Todd, A., Nakasato, J., & Esperanza, J. (2009). A randomized controlled trial of school-wide positive behavior support in elementary schools. *Journal of Positive Behavior Interventions, 11*, 133–144.

Hunter, L., & Chopra, V. (2001). Two proactive primary prevention program models that work in schools. *Report on Emotional & Behavioral Disorders in Youth, 1*, 57– 61.

Kelley, M. (1990). *School-home notes: Promoting children's classroom success.* New York, NY: Guilford Press.

Kingery, P. M., & Walker, H. M. (2002). What we know about school safety. In M. R. Shinn, H. M. Walker, & G. Stoner (Eds.), *Interventions for academic and behavior problems: Vol. 2. Preventive and remedial approaches* (pp. 71–88). Bethesda, MD: National Association of School Psychologists.

Kitzhaber, J. (2001, February). *A prevention agenda for Oregon's at-risk children.* Address given at a statewide early childhood conference, Portland, OR.

Leff, S., Waasdorp, T., Paskewich, B., Gullan, R., Jawad, A., MacEvoy, J., . . . Power, T. (2009). The preventing relational aggression in schools everyday program: A preliminary evaluation of acceptability and impact. *School Psychology Review, 39*(4), 569–587.

Lewis, T. J., Sugai, G., & Colvin, G. (1998). Reducing problem behavior through a schoolside system of effective behavioral support: Investigation of a school-wide social skills training program and contextual interventions. *School Psychology Review, 27*, 446–459.

Loeber, R., & Farrington, D. P. (Eds.). (1998). *Serious and violent juvenile offenders: Risk factors and successful interventions.* Thousand Oaks, CA: Sage.

Lynam, D. (1996). Early identification of chronic offenders: Who is the fledgling psychopath? *Psychological Bulletin, 120*, 209–234.

Patterson, G. R. (1982). *Coercive family process: Vol. 3. A social learning approach.* Eugene, OR: Castalia.

Patterson, G. R., Reid, J. B., & Dishion, T. J. (1992). *Antisocial boys.* Eugene, OR: Castalia Press.

Perlstein, L. (2001, July 11). Schools awash in bad behavior: Area educators complain of students out of control. *Washington Post,* p. B1.

Reid, J., Patterson, G. R., & Snyder, J. (Eds.). (2002). *Antisocial behavior in children and adolescents: A developmental analysis and the Oregon model for intervention.* Washington, DC: American Psychological Association.

Rogers, E. (1995). *Diffusion of innovations* (4th ed.). London, UK: Free Press.

Ross, A. (1980). *Psychological disorders of children: A behavioral approach to theory, research, and therapy* (2nd ed.). New York, NY: McGraw-Hill.

Schneider, B. (1992). Didactic methods for enhancing children's peer relations: A quantitative review. *Clinical Psychology Review, 12*, 363–382.

Seeley, J., Rohde, P., & Jones, L. (2010). School-based prevention and intervention for depression and suicidal behavior. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 363–396). Bethesda, MD: National Association of School Psychologists.

Severson, H., Walker, H., Hope-Doolittle, J., Kratochwill, T., & Gresham, F. M. (2007). Proactive early screening to detect behaviorally at-risk students: Issues, approaches, emerging innovations, and professional practices. *Journal of School Psychology, 45*, 193–223.

Shinn, M. R. (2010). Building a scientifically based data system for progress monitoring and universal screening across three tiers, including RTI using curriculum-based measurement. In M. R. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 259–292). Bethesda, MD: National Association of School Psychologists,.

Shinn, M. R., & Walker, H. M. (Eds.). (2010). *Interventions for achievement and behavior problems in a three-tier model including RTI.* Bethesda, MD: National Association of School Psychologists.

Shinn, M. R., Walker, H. M., & Stoner, G. (Eds.). (2002). *Interventions for academic and behavior problems: Vol. 2. Preventive and remedial approaches.* Bethesda, MD: National Association of School Psychologists.

Sprague, J. R., Sugai, G., Horner, R. H., & Walker, H. M. (1999, winter). Using office referral data to evaluate school-wide discipline and violence prevention interventions. *Oregon School Study Council Bulletin, 42*(2).

Sprague, J. R., & Walker, H. (2010). Building safe and healthy schools to promote school success: Critical issues, current challenges, and promising practices. In M. R. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 225–258). Bethesda, MD: National Association of School Psychologists.

Sprague, J. R., Walker, H., Golly, A., White, K., Myers, D., & Shannon, T. (2001). Translating research into effective practice: The effects of a universal staff and student intervention on indicators of discipline and school safety. *Education and Treatment of Children, 24*(4), 495–211.

Stokes, T. (1992). Discrimination and generalization. *Journal of Applied Behavior Analysis, 25*, 429–432.

Stokes, T., & Osnes, P. (1989). An operant pursuit of generalization. *Behavior Therapy, 20*, 337–355.

Sugai, G., Horner, R. H., & Gresham, F. M. (2002). Behaviorally effective school environments In M. R. Shinn, H. M. Walker & G. Stoner (Eds.), *Interventions for academic and behavior problems II: Preventive and remedial approaches* (pp. 315–350). Bethesda, MD: National Association of School Psychologists.

Sugai, G., Sprague, J. R., Horner, R. H., & Walker, H. M. (2000). Preventing school violence: The use of office discipline referrals to assess and monitor school-wide discipline interventions. In H. M. Walker & M. H. Epstein (Eds.), *Special series: School safety: Pt. 1. Journal of Emotional and Behavioral Disorders, 8*(2), 94–101.

Taylor-Green, S. J., & Kartub, D. T. (2000). Durable implementation of school-wide behavior support: The high five program. *Journal of Positive Behavior Interventions, 2*, 233–235.

Tobin, T., & Sugai, G. (1999). Predicting violence at school, chronic discipline problems, and high school outcomes from sixth graders' school records. *Journal of Emotional and Behavioral Disorders, 7*, 40–53.

Walker, H. M., Colvin, G., & Ramsey, E. (1995). *Antisocial behavior in schools: Strategies and best practices.* Pacific Grove, CA: Brooks/Cole.

Walker, H. M., Horner, R. H., Sugai, G., Bullis, M., Sprague, J. R., Bricker, D., & Kaufman, M. J. (1996). Integrated approaches to preventing antisocial behavior patterns among school-age children and youth. *Journal of Emotional and Behavioral Disorders, 4*, 193–256.

Walker, H. M., Irvin, L. K., Noell, J., & Singer, G. H. S. (1992). A construct score approach to the assessment of social competence: Rationale, technological considerations, and anticipated outcomes. *Behavior Modification, 16*, 448–474.

Walker, H. M., & McConnell, S. R. (1995). *Technical manual for the Walker-McConnell scale of social competence and school adjustment (SSCSA).* San Diego, CA: Singular.

Walker, H. M., Nishioka, V. M., Zeller, R., Bullis, M., & Sprague, J. R. (2001). School-based screening, identification, and service-delivery issues. *Report on Emotional & Behavioral Disorders in Youth, 1*(3), 51–52, 67–70.

Walker, H. M., Nishioka, V., Zeller, R., Severson, H., & Feil, E. (2001). Causal factors and partial solutions for the persistent under-identification of students having emotional and behavioral disorders in the context of schooling. *Assessment for effective intervention, 26*, 29–40.

Walker, H. M., Ramsey, E., & Gresham, F. M. (2004). *Antisocial behavior in school: Evidence-based practices.* Belmont, CA: Wadsworth/Thomson Learning.

Walker, H. M., Seeley, J., Small, J., Severson, H., Graham, B., Feil, E., . . . Forness, S. (2009). A randomized controlled trial of the first step to success early intervention: Demonstration of program efficacy outcomes in a diverse, urban school district. *Journal of Emotional and Behavioral Disorders, 17*, 197, 212.

Walker, H. M., & Severson, H. (1990). *The systematic screening for behavior disorders (SSBD)* procedure. Longmont, CO: Sopris West Educational Services/Cambium Learning Group.

Walker, H. M., Severson, H., & Seeley, J. (2010). Universal, school-based screening for the early detection of behavioral problems contributing to later destructive outcome. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 677–702). Bethesda, MD: National Association of School Psychologists.

Walker, H., & Shinn, M. (2002). Structuring school-based interventions to achieve integrated primary, secondary, and tertiary prevention goals for safe and effective schools. In M. Shinn, H. Walker, & G. Stoner (Eds.), *Interventions for academic and behavior problems II: Preventive and remedial approaches* (pp. 1–26). Bethesda, MD: National Association of School Psychologists.

Walker, H. M., & Shinn, M. R. (2010). Systemic, evidence-based approaches for promoting positive student outcomes within a multitier framework: Moving from efficacy to effectiveness. In M. R. Shinn & Walker, H. M. (Eds.), *Interventions for achievement and behavior problems within a three-tier model including RTI* (pp. 1–26). Bethesda, MD: National Association of School Psychologists.

Walker, H. M., Stieber, S., Ramsey, E., & O'Neill, R. (1993). Fifth grade school adjustment and later arrest rate: A longitudinal study of middle school antisocial boys. *Journal of Child and Family Studies, 2*(4), 295–315.

Walker, H. M., & Walker, J. E. (1991). *Coping with noncompliance in the classroom: A positive approach for teachers.* Austin, TX: PRO-ED.

Walker, H. M., Zeller, R. W., Close, D. W., Webber, J., & Gresham, F. M. (1999). The present unwrapped: Change and challenge in the field of behavior disorders. *Behavioral Disorders, 24*(4), 293–304.

APPENDIX A: RESULTS OF THE 2010 OSEP SUMMIT CONFERENCE ON THE CURRENT AND DESIRED STATES OF THE BD FIELD

Listings are provided below of consensus results for each prioritized, major category resulting from a combination of the preconference gap analysis and expert panel deliberations with OSEP program officers over a 2-day period. The "current state items" generally indicated an unsatisfactory condition or status as perceived by the panelists and the "desired state items" indicated a satisfactory condition or status to be achieved.

Across all categories

Current state	Desired state
	Social/ecological context
	Family partnerships
	Good teaching
	General education responsibilities
	General education training
	State certification requirements
	Integration social/emotional/behavior role in academic achievement
	Policy context: adopt zero reject model of student placements into general education
	Ongoing personnel development support (training/coaching)

Screening and identification

Current state	Desired state
Nonresponders	Response to intervention logic
Screened sporadically	Nonresponders
Lack of systematic early identification	Screened systematically
Institutional bias against labeling	Mental health screening
Disproportionality	Universal screening
Problematic definition of ED	Early identification
Inconsistent procedures for identification	Culturally responsive
Social maladjustment	Consistency in identifying ED
Definitions for students who should be considered at-risk	Federal definition of ED
Underidentification	Define learning more broadly
Underserved student populations	Understanding ecological context
	Continuous identification
	Attention to key transition periods and points in a student's career (K–12)

Instruction and interventions

Current state	Desired state
Interventions not applied systematically	Behavioral interventions that are implemented with fidelity
Interventions not paired with community treatments	Community treatments
Fail to address challenging behaviors	Early prevention and intervention
Not in place in many preschools nationwide	Assistance is provided within the context of high-quality, inclusive center programs
Data are not used for decision making	Intensity and individualization is graduated on the basis of the severity of the delay/disorder
Poor families do not have access to services and supports	Direct social skills instruction
Administrators lacking fundamental understanding of BD	Students systematically monitor and self-regulate
Evidence-based approaches and interventions are still underutilized	Zero tolerance is replaced with zero reject
Services appear to be bare bones	All schools have access to behavioral expertise
Prevention services are offered too little, too late.	Focus on the development of new capacities/strengths
Students are un-served or inadequately served	Every primary grade teacher would be able to implement evidence-based universal approaches
Prevention tends to be highly focused at the universal level	All children would have access to and excellent public school with high quality, scientifically based instruction differentiated to meet their needs

(*continued*)

Students frequently referred for a special education evaluation too quickly	Schools would establish safe and welcoming environments that engage and challenge students to develop their full potential
Reliance on "Wait to Fail" model	Strong student support teams
Emphasis on punishment without alternatives	Focus would be on preventive, positive discipline approaches
Students fail to demonstrate appropriate academic achievement	Effective instruction
Assessment practices are not always psychometrically sound, do not always provide useful and practical information	Students read at or near grade level
Too many students without a quality IEP, function-based BIP, or wraparound services plan	Appropriate academic achievement
Not enough time	Teachers are well versed in using scientifically based instruction
Good behavior plans are designed, but less often are they implemented well	Improved, valid, and web-based student progress monitoring tools
Inconsistent delivery of social-behavioral skills instruction	Data collection and analysis
Restrictive settings—once removed to these settings students do not easily return to less restrictive settings	Evidence-based behavioral interventions
Reliance on pull-out models	Inclusive settings
Lack of related "ownership" of student problems with responsibility to solve them	Focus on developing social and academic skills that will enable them to succeed in less restrictive placements
The focus of program decisions is on helping adults rather than helping students	Clear and consistent system for providing alternatives to out of school suspension or expulsion
Specialized placements viewed and treated as student "dumping grounds"	Belief that students with EBD can succeed academically, socially, and emotionally
Isolated supports are not integrated into school district service systems	Therapeutic day treatment opportunities well-coordinated with home schools and districts
Do not access needed mental health services in schools	A seamless continuum of services in schools and communities
Difficulties with interagency collaborations	ED is a heterogeneous population
Services are often limited to those provided in the special education classroom	Each school district would use a public health approach to determine the range and needs of the population
Ineffective use of mental health staff	Community and family supports are integrated with the school program
Mental health staff seem unprepared and untrained	Quality indicators and highlight exemplary programs
Special education teachers and mental health providers do not always communicate effectively	Quality of EBD student's relationships monitored
School climate and cultures are less than positive for students at risk for or with ED	A variety of educational options would be available for high school students
Interventions are not contextualized	Career planning and aptitude testing
Vulnerable students are victimized by bullying	Relationships with peers
Limited access to meaningful extracurricular activities	RTI/Three-tiered Model-Integrated Model
High school students receive less support	Additive model-academic and behavior
Insufficient options are available for high school age students	Comprehensive support for implementing
Racial disproportionality in delivery and out of school sanctions	Teachers have access to knowledge of EBP
	Manualized instruction
	Teachers as decision makers
	Instruction includes social/emotional learning (with accountability)
	Have school climate measures and language

Transition

Current state	Desired state
Students fail to demonstrate satisfactory transition outcomes	Need for effective transition plans
Limited supports provided to struggling students and provided too late	Quality support services provided that begin early
Research on effective transition programs is limited	Need after care for exiting reintegration program models
	Involved families

	Broadening transition options/clear definitions of transition/benchmarks
	Broader context—Communities/families
	Streamlined coordination of services—funding follows
	Linking in-school instruction to postschool goals

Outcomes

Current state	Desired state
School administration and school policies fail to make social emotional learning, behavior, and mental health top priorities along with academic outcomes	Outcomes should focus on relevant and realistic academic and social/behavioral goals
Poor employment outcomes/high levels of incarceration—need to expand interagency collaboration	Students with EBD would have the skills, competencies and natural social supports necessary to function independently and productively as adults
Negative stigma	

PBIS and three-tiered models

Current state	Desired state
Primary prevention, such as PBIS, is not universally available in all schools	Schools would utilize a multitiered approach to providing services and evidence-based interventions at increasing levels of intensity, to students who struggle with academic/behavior
Few schools use RTI/PBIS models for early intervening services and those that do, do not implement with fidelity.	More coordinated and comprehensive system that emphasizes a balance between promotion of positive mental health and prevention of mental health problems with treatment of mental health problems
Insufficient federal funding	Use public health model—(i.e., ReAiM)
More intensive prevention and treatment programs are required to compliment and augment PBS services	

Families and wraparound services

Current state	Desired state
Insufficient support to families	Families would also be supported
Lack of a well-resourced EBD parent advocacy group	Family members are full partners
The current state of services and outcomes for children and youth with or at risk of ED is mired in the perception (with some empirical support) that the majority of services are limited in their effectiveness and the academic and social outcomes	Effective liaisons to families
Bureaucratic silos that exist	Expanded community based programming/vocational training
Lack of conceptual guides	Coordinate home, school, and community services
	Creating support networks/permanency plans/ peer groups and community
	Peer support for parents

Personnel development

Current state	Desired state
Teachers of children with EBD seem not well prepared	Advanced methods courses
Lack of familiarity with, let alone competence in, foundations of classroom behavior management	Behavioral management courses
Poorly trained	Develop general education teachers who have the skill sets necessary
Failure of the EBD field to delineate clear competencies	Being the "specialist"
Train and hope without sufficient resources	Teachers would have the skills necessary to be critical consumers
Many teachers do not keep current	General and special education teachers are competent in managing student behavior
Teacher preparation has changed from mostly categorical to noncategorical preparation	Coordinated ongoing professional development
Insufficient federal funding for teacher preparation	In-class coaching and problem-solving assistance

(*continued*)

Administrators' personnel preparation programs in need of additional information on serving students with ED	A yearlong paid residency
Recruitment and retention of teachers with EBD continues to be problematic	School administrators would be trained
	Adopt a "Teach for America" approach
	State Certification—Behavior
	Preservice and inservice focus (linking IHE and district/State)
	Emphasis on building fluency (inservice)—district/state infrastructure
	Core competencies (tiered)
	Collection and use of data

Research and dissemination

Current state	**Desired state**
Three-tiered models have not been well-studied	Studies of three-tiered models are periodically conducted
Limited knowledge of what are evidence-based practices for students with and at risk for EBD	Fidelity in implementation of evidence-based practices is emphasized
Guidelines for evidence-based practices need to be put in place	Guidelines generated by a professional panel and based on empirical research
Limited funding to support longitudinal research	Federal funding for research
	Coordinate

CHAPTER 18

Learning and Pedagogy in Initial Teacher Preparation

JENNIFER A. WHITCOMB

INTRODUCTION

Current Landscape for Teacher Education

Learning to teach is both cognitively and emotionally challenging. Examinations of teaching (e.g., Cohen, 2011; Jackson, 1968; Lampert, 2001; McDonald, 1992) point out the uncertainty, complexity, and immediacy that characterize the practice of teaching. Over the past 30 years scholarly efforts to elevate the standing of teaching to a profession on par with medicine or law have identified both a knowledge base teachers must understand in order to teach children well and the complex judgments teachers make on a regular basis. However, a contrasting camp has persistently sought to deregulate initial teacher preparation, arguing that the knowledge for teaching is comprised primarily of deep subject matter knowledge and selected teaching techniques or strategies. The current context of public education poses many formidable challenges for teachers: Among them are the public's mandate to ensure *all* children have deep, flexible knowledge and skills to succeed in a global, information-based society; teaching shortages in critical areas; the legacy of poverty that some children inherit; increasing ethnic and linguistic diversity that presses us to revisit our understanding and enactment of democratic principles; and increasing calls for accountability in the form of standardized test scores. How best to prepare teacher candidates to teach in this demanding context is a vexing question. Furthermore, it must be answered in a factious policy environment that is deeply divided in its responses to the challenges of designing and carrying out initial teacher preparation (e.g., Darling-Hammond, 2006; Finn, 2001; D. Imig & Imig, 2008; National Commission on Teaching and America's Future, 1996; Wilson & Tamir, 2008).

Though teacher education has been under attack since at least the 1930s (Fraser, 2007), during the first 10 years of the 21st century, critiques of university-based teacher education have been particularly pointed and heated (e.g., Duncan, 2009; Hess, Rotherham, & Walsh, 2004; Levine, 2006). The long-standing critiques of both the quality and content of teacher education typically find the following faults with university-based programs: a lack of intellectual rigor in education courses; a lack of attention by universities to the practical realities of work in schools; weak relationships between field experiences and university courses; an overemphasis on progressive pedagogies; and low admission standards. The most recent round of critiques speak more directly to current challenges of teaching in K–12 schools. Critics, who often understate the impact of poverty on children's educational experiences and outcomes, note the following problems with current models of teacher education: wide variation within and among programs; a demographic mismatch between the largely monolingual, white, and female population graduating from teacher education programs with the ethnic, cultural, and linguistic diversity of children and youth in K–12 schools; the inability of teacher education programs to prepare teachers who stay long enough to make a difference in schools that serve poverty-impacted students and communities; and the inability of teacher preparation programs to prepare reliably teachers who foster student learning, as measured on large-scale tests. These persistent critiques have spurred and been spurred by a relentless attack in the media (e.g., Hartocollis, 2005; Otterman, 2011; Will, 2006). A policy agenda favoring a broadening of pathways into teaching and a narrow definition of teacher effectiveness has flourished. Overall, the first decade of the 21st century has witnessed a heated debate about which pathways produce the most effective educators. Wilson and Tamir (2008) characterize this debate as a "jurisdictional challenge" pitting the "orthodoxy" of university-based teacher preparation against the "heterodoxy" of alternative routes. Although the outcome of this jurisdictional dispute remains up for grabs, what is clear is that university-based teacher education will look significantly different by 2025.

Rigor and Methodological Pluralism in Research on Learning to Teach

Rigorous research plays a role in navigating this contested terrain of how teachers will be prepared, particularly as new models emerge that reflect research-based understandings of how people learn to teach. Within the first decade of the 21st century scholars of teacher learning made compelling arguments for increased rigor and methodological pluralism. In many regards debates about rigor in teacher education research mirrored the larger conversation about quality of educational research in the field as a whole. That debate, captured in the National Research Council's 2002 and 2005 reports (Shavelson & Towne, 2002; Towne, Wise, & Winters, 2004), explored both what counts as high-quality empirical evidence and what research designs and methods are most likely to guide policy and practice reform initiatives. The National Research Council's work responded to persistent critiques leveled by some that education research will not overcome its "credibility gap" until it adopts a research model more like the field of medicine (e.g., Levin & O'Donnell, 1999). Levin and O'Donnell press for a four-stage process of educational inquiry that begins with pilot studies, proceeds to a combination of controlled laboratory experiments and classroom-based design experiments, moves next to randomized classroom trials, and then culminates with informed classroom practice. While debate still swirls about whether or not randomized controlled trials are indeed the "gold standard" in educational research, the National Research Council's work focuses the field on principles of inquiry, rather than particular research methods or genres, as indicators of rigor and quality. Furthermore, while recognizing the importance of randomized controlled trials, particularly when the aim is to make causal claims, the Council affirmed the importance of research conducted from multiple disciplinary lenses and using multiple methods as essential to understanding the complexity of educational activities.

Turning to research on teacher education more specifically, Cochran-Smith and Fries (2001) point out the term rigor has the potential to be used loosely and rhetorically to imply high standards for research, whether they have been met. They critique the "evidentiary warrant" of rigorous, empirical research. Though they recognize that such research may help to resolve persistent problems in teacher education, they also argue that divisive ideological dilemmas in teacher education require further deliberation. They go on to suggest that evidence alone will not resolve the normative debates about how best to prepare teachers. Also required, they say, is careful scrutiny and analysis of the "assumptions and motivations that underlie the establishment of different initiatives in the first place as well as the values and political purposes attached to them" (p. 13). Their historical overview of researching teacher education extends this argument as it explicates how different framings of the "problem of teacher education" reflect the contested nature of this endeavor (Cochran-Smith & Fries, 2005). They make a persuasive case for how the political and professional contexts of a period shape how research on teacher education is ultimately conceptualized and conducted as either a problem of training, a problem of learning, or a problem of policy.

Given the complexity of learning to teach and teacher education, Kennedy (1996, 1999a) argues for methodological pluralism as a means of "capturing the entire story." She maintains that research in teacher education must have robust designs, particularly if teacher educators want to defend themselves from skeptics' challenges. Kennedy's framework delineates the following five genres for researching teacher learning: multiple-regression, follow-up surveys (e.g., to program alumni), comparative population studies (e.g., between credentialed and non-credentialed teachers), experiments and quasi-experiments in teacher education, and longitudinal studies (e.g., case studies examining teacher change). Zeichner (1999) develops a similar list; although, he includes two different research categories, conceptual/historical and self-study research. Borko, Whitcomb, and Byrnes (2008) parse the field a bit differently by describing four genres—effects of teacher education research, interpretive research, practitioner research, and design research. Collectively, these analyses of the affordances and constraints of research genres point to a field enriched by varied intellectual roots and methodological traditions.

Situating This Chapter in a Larger Conversation

Given the larger backdrop of persistent challenges to the quality of educational research and the precedence for inquiry initiated from multiple genres, in this chapter the term *rigorous research* refers to empirical work that meets the principles of inquiry advanced in the National Research Council's report on *Scientific Research in Education* (Shavelson & Towne, 2002). For example, a rigorous study outlines its conceptual framework, its normative assumptions, and its clear relationship to prior studies. Second, a rigorous study provides explicit and detailed description of its design, data, and analysis so that readers may assess the validity of the findings. In this review, a preference for research published in refereed journals is acknowledged, for such studies have undergone the process of peer-review. Not all scholarship reviewed in this chapter, however, is empirical; also included is conceptual scholarship that either inspires a substantive body of empirical research or that provides critical commentary on empirical work.

Though many disciplines comprise the field of education, educational psychology guides us toward the central role teacher cognition plays in learning to teach. Giving definition to the discipline, Berliner and Calfee (1996) assert, "[E]ducational psychology is distinctive in its substance: *the systematic study of the individual in context* [original emphasis]" (p. 6). Research in teacher education from this lens asks questions about "how teachers acquire, generate, and learn to use the knowledge of teaching" (Feiman-Nemser, 2008). The discipline's particular ways of problem construction, theories, and methodologies have yielded insights into the nature and development of teacher beliefs, understanding of subject matter, problem solving, decision making, and reflection. Scholarship from this vantage point has helped to shape an image of teaching as an intellectual profession that requires its practitioners to synthesize a sizeable knowledge base, to deliberate and reason using this knowledge base, and to reconstruct and reflect on lived experience in order to learn from it. More recent work from a situative perspective deepens our understanding of how learning to teach occurs as individuals participate in the social and cultural practices of teaching in schools and other settings, engage in identity formation, and appropriate conceptual and practical tools.

Handbook chapters, as a scholarly genre, offer selective, focused reviews of the literature. Though teaching and learning to teach have been studied from a range of disciplinary viewpoints, handbooks of educational psychology have typically addressed teaching processes and learning to teach and as such have informed the field in important ways (e.g., Borko & Putnam, 1996; Pressley et al., 2002). Despite the fact that the field of research on teacher education is young (Wilson, Floden, & Ferrini-Mundy, 2001), scholars have been active in this field over the past 20 years. For example, six handbooks synthesizing and codifying research in this area have been published since 1990 (Ball & Tyson, 2010; Cochran-Smith, Feiman-Nemser, & McIntyre, 2008; Cochran-Smith & Zeichner, 2005; Houston, 1990; Murray, 1996a; Sikula, Buttery, & Gutyon, 1996). Two handbooks of research on teaching have also been published (Biddle, Good, & Goodson, 1997; Richardson, 2001). Within all these handbooks, many chapters review research conducted within a cognitive and/or situative framework (e.g., Borko & Putnam, 1996; Calderhead, 1996; Feiman-Nemser & Remillard, 1996; Putnam & Borko, 1997; Richardson & Placier, 2001; Rosaen & Florio-Ruane, 2008). Additionally several noteworthy reviews of the research literature on learning to teach have been published (Ball & Cohen, 1999; Bransford, Derry, Berliner, Hammerness, 2005; Darling-Hammond, Wei, & Johnson, 2009; Griffith & Early, 1999; National Research Council, 2010; Putnam & Borko, 2000; Wideen, Mayer-Smith, & Moon, 1998; Wilson et al., 2001).

To address the breadth of this field is beyond the scope of this, or any, chapter. Accordingly, this chapter focuses primarily upon research conducted within a cognitive or situative psychological framework that examines individual teacher candidate's learning to teach in the context of initial teacher preparation (ITP). In this chapter, ITP refers to the bounded set of experiences comprising the formal study of teaching, learning, and schools that is most typically conducted in both academic courses and field experiences, though the contexts for teacher learning are shifting dramatically as schools, universities, and workplaces design new teacher learning environments that take advantage of social and digital media tools. These experiences are designed to prepare individuals for initial teaching licenses. Such preparation programs may or may not be housed at a university and may be completed at either undergraduate or graduate levels.

The choice of a psychological framework, with its attendant consideration of individuals learning in contexts, is deliberate. First, this lens reflects this volume's theme. Second, it ensures this review explicitly builds upon several seminal comprehensive reviews within this same framework (e.g., Borko & Putnam, 1996; Putnam & Borko, 1997, 2000). Third, individual teacher candidate's learning is a relentless focus of teacher educators. At the conclusion of ITP, institution(s) must be able to judge whether a particular candidate's knowledge, performance, and dispositions meet the entering standards of the profession. Though new conceptions of knowledge and learning emphasize the social and distributed nature of cognition, ultimately each individual must demonstrate his or her knowledge/practice. Finally, attention to context ensures that researchers consider the multiple and overlapping contexts in which ITP occurs. Indeed, the interaction between cognition and context is at the forefront of work in many domains of educational psychology and the learning sciences.

As with any choice, there are attendant losses. By making the figure of this review cognitively framed studies of new teacher's learning, illustrative and important work that considers practicing teacher's learning in the contexts of professional development is relegated to the background (e.g., Wilson & Berne, 1999). Also left out are studies that reflect other disciplinary or theoretical orientations to the study of new teacher's learning, for example, philosophical, critical, historical, feminist, anthropological, and sociological (Britzman, 2003; Buchmann & Floden, 1993; Cochran-Smith, 1991; King, Hollins, & Hayman, 1997; Lucas, 1997; McWilliam, 1994; Tabachnich & Zeichner, 1991; Zeichner, Melnick, & Gomez, 1996).

Throughout the chapter rigorously conducted research is highlighted. Scholarship of learning to teach, in general, has no shortage of normative arguments for what teacher candidates should learn and how that preparation should be carried out. Indeed, there is speculation that conflicting visions of the purposes of teacher preparation may not be reconciled (Whitcomb, 2010). A need exists, therefore, for systematically gathered, empirical evidence to study these arguments. The chapter synthesizes essential conceptualizations and empirical findings regarding what teacher candidates learn and how they do so; throughout, it highlights promising research from a situative perspective.

In the latter part of the 1990s, several handbook chapters and reviews of the literature on learning to teach synthesized a burst of cognitively oriented research conducted in the 1980s and early 1990s. That scholarship examined the nature and development of teacher thinking and teacher knowledge. The depth of these chapters suggest that formal inquiry into learning to teach is indeed a subdiscipline within the field of educational psychology (Borko & Putnam, 1996; Calderhead, 1996; Feiman-Nemser & Remillard, 1996; Murray, 1996b; Putnam & Borko, 1997, 2000). Much of the research reviewed reflects broader trends within educational psychology—for example, the establishment of cognitivism as an overarching "paradigm" and the rise of constructivism as a theory of learning; a broadening of research methodologies, particularly the inclusion of qualitatively-designed studies; and an emphasis on practice (Berliner & Calfee, 1996; Pressley & Roehrig, 2002).

Guiding the development of a collective story from these reviews and other seminal studies in the area of teacher learning and pedagogy in teacher preparation were the following questions: How has research conducted within a cognitive framework illuminated our understanding of both what new teachers should know and also how they learn? How has research within a cognitive framework shaped and informed key dilemmas of ITP (e.g., teaching in ways that are responsive to culturally and linguistically diverse students, teaching for understanding, issues of transferring knowledge from one setting to another)? What does this literature on teacher learning have to say about pedagogical practices in ITP? To answer these questions, this section traces how a "cognitive framework" has evolved, noting in particular recent emphasis on a situative perspective; describes different approaches to defining a knowledge base for teaching; summarizes key findings from studies of how teachers learn; and reviews scholarly analyses of pedagogy in teacher preparation.

EVOLVING CONCEPTUAL FRAMEWORKS TO STUDY LEARNING TO TEACH

A conceptual framework feeds a study's design, for it shapes the questions posed, the methods used, the researcher's stance, and the settings in which inquiry is conducted. The scholarly team of Borko and Putnam (1996, 1997, 2000—note citations rotate authorship) produced several influential reviews that synthesize an evolution in conceptual frameworks used to study teacher's thought and learning. This evolution reflects shifts in perspective that have shaped and reshaped the broader field of educational psychology, notably a progression from behaviorist to cognitivist to sociocultural or situative perspectives. With each shift, a revised understanding of what constitutes powerful learning has emerged. In broad strokes, there has been a movement from a receptive/accrual view of learning to a cognitive/mediational view (Anderson, 1989). Evolving conceptual frameworks for studying learning to teach, by extension reflect evolving understandings of the image of an accomplished teacher.

Behaviorist Perspective

Much of the process-product research, conducted in the 1950s through the 1970s, drew upon behaviorism as its conceptual framework (Brophy & Good, 1986). Emphasizing the teacher's effective management of learning, process-product classroom-based studies sought to correlate specific teacher actions and talk with student achievement on standardized tests. Research in this tradition yielded a rather atomistic view of teaching, parsing teaching into specific behaviors or sequences of behaviors that were more consistent with a receptive/accrual view of student learning. The image of accomplished teaching that emerged from this research was of an individual who directs the flow of activities and talk so that all students are engaged and progressing in an efficient, orderly manner (Clark, 1995). The implications for ITP meant that teacher candidates were presented with discrete knowledge and practices that had been proven effective in process-product studies. Often these were introduced in teaching laboratories and simulations (Carter & Anders, 1996). Eventually, teacher candidates were expected to assemble separate skills together to execute effective practice. In the current policy/practice debate about teacher education, calls for more attention to training new teachers to learn proven strategies (e.g., Lemov, 2010) reflect a neo-behaviorist approach to learning to teach.

Cognitive Constructivist Perspectives

During the mid-1970s in response to a growing sense of inadequacy regarding the findings and methods of process-product research (Calderhead, 1996), scholars shifted attention to teacher's cognition or mental lives. This body of research, initially reflected an information-processing view of the mind but subsequently adopted a constructivist view of cognition. Studies elaborated the complexity of teacher's intentions, planning, decision making, problem solving (Clark & Peterson, 1986). Teacher thinking about classroom management, instructional choices, use of class time, and checking for understanding fueled research (Richardson-Koehler, 1987). Empirical evidence began to mount highlighting the powerful role that teacher beliefs played in teacher's thought processes (Calderhead, 1996). Images of accomplished teaching were captured in metaphors such as the teacher as diagnostician, as decision-maker, and as reflective-practioner (Clark, 1995).

Research on teacher thinking overlapped with studies of teacher knowledge. Shulman and his colleagues in the "Knowledge Growth and Teaching Project" (e.g., Grossman, Wilson, & Shulman, 1989; Wilson, Shulman, & Richert, 1987; Wilson & Wineburg, 1988) played a central role in shaping this line of research, which characterized the knowledge base that informs teacher's thinking and the dynamic, personalized manner in which each teacher comes to understand this knowledge. Shulman's introduction to the third *Handbook of Research on Teaching* identified content as a "missing paradigm" of research on teaching (1986a). Shulman and his colleagues fleshed out an enormously generative concept, pedagogical content knowledge, which broadly speaking refers to the specialized knowledge teachers have of how to represent content knowledge in multiple ways to learners.

Grossman (1990) in her landmark study outlined four components of pedagogical content knowledge:

> (1) [A]n overarching conception of what it means to teach a particular subject, (2) knowledge of instructional strategies and representations for teaching particular topics, (3) knowledge of students' understanding and potential misunderstandings of a subject area, and (4) knowledge of curriculum and curricular materials.'' (as cited in Borko & Putnam, 1996, p. 690)

So, for example, if a science teacher views teaching biology as a form of inquiry, she might emphasize open-ended lab and problem-based experiences over lectures and textbook reading. That same biology teacher must have at her fingertips a range of ways to represent key concepts such as photosynthesis or the replication of DNA, and these representations must go beyond equations. She also needs to anticipate students' likely confusion regarding these concepts, particularly those that might arise in the process of collecting, analyzing, and interpreting data. Finally, she needs to know the many curricular material resources available to help students grapple with and make sense of these concepts. Bruner's bold hypothesis "that any subject can be taught effectively in some intellectually honest form to any child at any stage of development" (1960, p. 33) as well as Schwab's (1964) delineation between the substance and syntax of the disciplines resonate in Shulman's writing.

Deborah Ball and her colleagues have further refined our understandings of how teachers know content by making a conceptual and empirical argument that teachers of mathematics hold a specialized content knowledge that is distinct from both common content knowledge nonteachers hold and specialized content knowledge mathematicians hold (Ball, Thames, & Phelps, 2008). They study actual mathematics teaching, zooming in on problems of practice, to delineate knowledge of mathematics *for* teaching. Their analyses of practice illustrate how tasks entailed in the work of teaching such as "looking for patterns in student errors or in sizing up whether a nonstandard approach would work in general . . . involve an uncanny kind of unpacking of mathematics that is not needed—or even desirable—in settings other than teaching" (p. 400). Theirs is a promising extension of Shulman's notions of pedagogical content knowledge because they show this form of knowledge as it is embedded or situated in teacher's practice. In this way, Ball and colleagues offer a research-based counter-argument to those who claim that teachers merely need to know their content.

Propelling the emphasis on teachers' understanding of their subject matter were two other large-scale standards-based reforms. First, in 1987 the National Board for Professional Teaching Standards was established, which developed rigorous standards for expert veterans and means of assessing them. Second, most national subject matter organizations developed standards for what students should know and be able to do at the conclusion of K-12 education. The emerging "reform" vision challenged teachers to "teach for understanding" (Blumenfeld, Marx, Patrick, Krajcik, & Soloway, 1997; Cohen, McLaughlin, & Talbert, 1993; Darling-Hammond, 1997). In general, teaching for understanding emphasizes student's active, cognitive transformation of knowledge; it is typically contrasted with passive, receptive acquisition of knowledge. Several rhetorically loaded terms are also used as synonyms for teaching for understanding, e.g., adventurous teaching (Cohen, 1989), reform-minded teaching, and ambitious teaching. Indeed, the term *ambitious* peppers the literature reviews on teacher learning (e.g., Ball & Cohen, 1999; Feiman-Nemser & Remillard, 1996; Borko and Putnam, 1996; Putnam & Borko, 1997, 2000; Richardson, 1996). Putnam and Borko (1997) provide a thoughtfully concise explanation of this rhetorical term. They write,

> [T]he sorts of teaching that are being promoted in most current, scholarly reform movements—[are] approaches that emphasize the importance of students' thinking and the development of powerful reasoning and understanding within subject-matter domains. In many cases, reformers are calling for teachers to enhance, and sometimes supplant, the 'direct instruction' models of teaching that pervade today's public school classrooms by providing opportunities for students to explore ideas in rich contexts, rather than relying primarily on teacher presentation and student rehearsal. Because teaching for these goals entails thinking of subject-matter content in new ways and being attentive and responsive to the thinking of students, teaching cannot be prescribed in advance as a set of techniques to be carried out in a particular way. Rather, these approaches require teachers to think differently about students, subject matter, and the learning process and to become more "adventurous" in their teaching. (p. 1229)

It should be noted, however, that the concept of "teaching for understanding," which is referred to by its proponents as a "reform-minded" approach is a contested notion. For example, Lisa Delpit (1995) thoughtfully critiques progressive pedagogies as she explores the assumptions, values, and implications of process-oriented writing pedagogy, particularly for non-white students. In the end, the idea of teaching for understanding casts the image of the accomplished teacher as an academic coach or intellectual guide, shepherding communities of learners as they construct an understanding of major ideas and ways of thinking within each discipline. To fulfill this role, the teacher must also engage as a practical scholar of his/her discipline and must possess great sociocultural sensitivity to the learners under her care, particularly as contemporary schools grow more culturally and linguistically heterogeneous. Fostering the development of such awareness and cross-cultural competence is a vexing challenge in teacher education (Achinstein & Aguierre, 2008; Villegas, 2007).

Along with studies of teacher's knowledge of content, a number of researchers, strongly influenced by interpretive methods in other disciplines, began to explore how teacher candidate's personal narrative and life histories influence learning to teach (e.g., Carter, 1990; Clandinin & Connelly, 1987; Elbaz, 1983; Kagan, 1992; Louden, 1991; Ross, Cornett, & McCutcheon, 1992; Zeichner, Tabachnich, & Densmore, 1987). Carter and Doyle (1996) synthesize this body of research, which emphasizes the centrality of teacher candidate's personal construction of personal practical knowledge. They conclude:

> From an outside perspective of program policy, becoming a teacher is all too often seen as obtaining credentials and acquiring skills. From a biographical frame, however, becoming a teacher means (a) transforming an identity, (b) adapting personal understandings and ideals to institutional realities,

> and (c) deciding how to express one's self in classroom activity . . . . [T]his is far more complex picture of the essence of the teacher education experience promises to transform fundamentally how teachers are viewed and perhaps even how they are valued. (p. 139)

Social Constructivist or Situative Perspectives

Amidst this burst of research on how individual teacher's knowledge and beliefs both develop and shape practice, researchers discovered, or rediscovered, the importance of context in cognition. This unfolded in several ways. First, teacher educators engaged teacher candidates in reflection about the context(s) in which they worked and in which the learners lived (e.g. King et al., 1997; Ladson-Billings, 1999). Second, renewed attention to the situated nature of cognition mirrored the evolution of cognitive constructivism to social constructivism (Nuthall, 1997). Putnam and Borko synthesize the situative perspective:

> Situative theorists challenge this assumption of a cognitive core independent of context and intention (Brown, Collins, & Duguid, 1989; Greeno & The Middle School Through Applications Project Group, 1998; Lave & Wenger, 1991). They posit, instead, that the physical and social contexts in which an activity takes place are an integral part of the activity, and that the activity is an integral part of the learning that takes place within it. How a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned. Further, whereas traditional cognitive perspectives focus on the individual as the basic unit of analysis, situative perspectives focus on interactive systems that include individuals as participants, interacting with each other as well as materials and representational systems (Cobb & Bowers, 1999; Greeno, 1997). (Putnam & Borko, 2000, p. 4)

As a learning theory, situated cognition, suggests that learning should be rooted in authentic activity; that learning occurs within a community of individuals engaged in inquiry and practice; that more knowledgeable "masters" guide or scaffold the learning of novices; and that expertise is often distributed across individuals, thus allowing the community to accomplish complex tasks that no single person could accomplish alone. In this view of learning, the accomplished teacher is one who orchestrates the flow of information amongst individuals, as one who assists, rather than controls, the learning of others, as one who "rouses minds to life" (Tharp & Gallimore, 1988).

Scholars of teacher learning see great potential in this conceptual framework (Putnam & Borko, 2000), and some of the most compelling work in the first decade of the 21st century reflects a situative perspective. At the heart of the situative perspective is the issue of transfer of learning from one setting to another; as such, it informs an ongoing dilemma in teacher education regarding the bridge between theory and practice (Dewey, 1904). Finding robust ways to negotiate between theory and practice matters when the goal of teacher preparation is to ensure new teachers can teach for understanding with culturally and linguistically diverse learners. Second, because a situative perspective focuses on interactive systems, it may help teacher educators develop theories of teacher learning that draw attention to the "interrelationship of knowledge and action in the classroom context and develop[s] an understanding that more accurately captures the cognitive, affective, and behavioral aspects of teachers' work" (Calderhead, 1996, p. 711). The situative perspective draws attention to the following aspects of ITP experience: activity settings, discourse, participation structures, and mediational tools. For instance, efforts to expand traditional classroom field experiences into community-based settings and/or to bring video of exemplary teaching for understanding into university courses reflect the understanding that learning to teach occurs primarily in situ. Efforts to create opportunities for authentic conversation and problem solving among teacher candidates and veterans are at the forefront of teacher education design, as teacher educators work to design learning environments that allow candidates to learn both *in* and *from* practice (Ball & Cohen, 1999). And, socio-cognitive tools, such as hyper-media case materials, have been created to provide more authentic tasks. The nature of teacher candidate's learning through participation in robustly designed environments using engaging socio-cognitive tools is a focus of research (Gutierrez & Vossoughi, 2010; Putnam & Borko, 1997; Richardson, 1997).

Summary of Conceptual Frameworks

In this overview to conceptual frameworks a chronological tidiness is implied that is not necessarily present in the many studies cited in this review. What is clear, however, is that as cognitive and situative conceptual frameworks emerged in the large field of learning theory, scholars of learning to teach quickly and easily appropriated them to conduct inquiries into learning to teach. As psychological frameworks evolved from behaviorist to a situative perspective, they inspired lines of research that provided broad empirical evidence for the cognitive complexity required to teach, particularly when the educative end is teaching for understanding and equity. In this overview to conceptual frameworks, the focus has been on those aspects of teacher learning and practice that each new framework has called attention to.

DEFINING A KNOWLEDGE BASE FOR TEACHER CANDIDATES

Conceptual frameworks help delineate the problem space of *how* individuals learn to teach. A different, but related line of research has sought to delineate *what* content is most essential for novice teacher learning. During the 1980s several scholars worked to specify a knowledge base grounded in the findings emerging from cognitive constructivist studies of teaching. This work was initiated, for the most part, to distinguish teaching as a profession, with a distinct and complex body of knowledge mastered by expert teachers. Landmark publications by Shulman (1986b, 1987) along with *Knowledge Base for the Beginning Teacher* (Reynolds, 1989) and later *The Teacher Educator's Handbook: Building a Knowledge Base for the Preparation of Teachers* (Murray, 1996a) mapped out the substance or content that teachers need to know. Three framings of the curricular domains of teacher education build on the scholarship of the 1980s and take into account the challenging realities teachers face in 21st-century classrooms, where teachers work to ensure the most culturally and linguistically diverse student population in the history of U.S. schools achieves the highest expectations for learning outcomes ever in the history of U.S. education. Teachers are at the forefront of closing the "opportunity gap" that presently exists in U.S. public education (Deshano da Silva, Huguley, Kakli, & Rao, 2007; Ladson-Billings, 2006), and this challenge has expanded our understanding of what knowledge teachers need to acquire and use as well as how they will do so.

The most comprehensive statement to guide a professional education curriculum is the National Academy of Education's landmark text, *Preparing Teachers for a Changing World: What Teachers Should Know and Be Able to Do* (Darling-Hammond & Bransford, 2005). The work synthesizes research from multiple fields to outline the domains of what teachers need to know. The monograph places a vision of professional practice at the center of its conceptual framework and then conceptually organizes essential knowledge for beginning teachers into three broad domains: (1) knowledge of learners and their development in social contexts (comprising understandings of learning, human development, and language development and use), (2) knowledge of subject matter and curriculum goals (comprising educational goals, and purposes for skills, content, and subject matter), and (3) knowledge of teaching (comprising content plus content pedagogy, teaching diverse learners, assessment, and classroom management). The emphasis on language and culture are most distinctive when comparing this set of domains to those advanced in the 1980s. However, what is most impressive is that the recommendations for *what* core ideas and broad understandings are most essential for beginning teachers are grounded in four kinds of research evidence—basic research on learning, development, and language acquisition in social contexts; research on how learning conditions and teaching practices influence learning; research on how teacher learning affects teaching practices and student outcomes; and research on how teachers learn successful practices. It is the conceptual richness of the framework coupled with a strong empirical base that makes this document a powerful driver of reform in teacher learning.

Feiman-Nemser (2001a) takes a more focused look at framing a knowledge base for teacher development. She offers a developmental continuum that outlines the central tasks of learning to teach, parsing specific tasks to be accomplished at the preservice, induction, and continuing professional development phases of a teacher's development. She identifies the following five tasks as the focus of preservice teacher education: "examine beliefs critically in relation to vision of good teaching, develop subject matter knowledge for teaching, develop an understanding of learners, learning, and issues of diversity; develop a beginning repertoire; develop the tools and dispositions to study teaching" (Feiman-Nemser, 2001a, p. 1050). While there is clear overlap with the domains enumerated in *Preparing Teachers,* the emphasis on the central tasks is intuitively appealing because it reinforces the notion that teachers generate understanding *in practice,* that learning is embedded in accomplishing the work of teaching. By articulating a developmental continuum, Feiman-Nemser reminds us to set appropriate limits on what is possible to learn to be a "well-started novice" (p. 1025). Her framework helps to temper the comprehensiveness of the National Academy's recommended curriculum and suggests the importance of detailing learning trajectories.

Ball and her colleagues have worked in a similar vein to articulate a "practice-focused" curriculum (Ball & Bass, 2003; Ball & Forzani, 2009; Ball, Sleep, Boerst, & Bass, 2009). In many ways, this line of research elaborates a beginner's repertoire, by drawing attention to the lack of a "shared taxonomy and language for core practices of teaching" (Ball et al., 2009, p. 460). Ball and colleagues envision a teacher preparation curriculum built around "core" or "high-leverage" practices (Grossman, Hammerness, & McDonald, 2009; Windshitl et al., in press).

> A practiced-focused curriculum for learning teaching would include significant attention not just to the knowledge demands of teaching but to the actual tasks and activities involved in the work. It would not settle for developing teachers' beliefs and commitments; instead, it would emphasize repeated opportunities for novices to practice carrying out the interactive work of teaching and not just to talk about that work. (Ball & Forzani, 2009, p. 503)

They specify the content of a practice-focused professional curriculum by examining the work of teaching and identifying those practices that are high frequency in a teacher's repertoire, ones a novice can enact in multiple contexts and master with some guidance, ones that help novices learn about students and teaching, and ones with a research base and potential to improve student achievement (Grossman, Hammerness, et al., 2009). For example, in elementary literacy classrooms, a high-leverage practice is conducting an effective read-aloud, In this approach, the professional education comprises deliberate opportunities for novices to decompose and approximate core practice (Grossman, Compton, et al., 2009). Ball's conceptualization of a practice-focused curriculum offers the field a sophisticated synthesis of the behaviorist, cognitivist, and situative perspectives on learning to teach.

HOW TEACHER CANDIDATES LEARN TO TEACH

The heart of learning to teach is the development of judgment, which involves the acquisition and integration of various forms and domains of knowledge to guide action for particular purposes in specific social and cultural contexts. Exercising sound judgment also brings in emotions and commitments. The prior discussion of the knowledge base for teaching, *what* candidates need to learn, enumerates several approaches to defining content or substance of a professional curriculum in ITP. These articulations invite larger questions about *how* one learns to teach. What counts as teacher learning and growth? How do different conceptual approaches describe learning teaching outcomes? Who decides what counts? For example, does or must teacher learning involve altered beliefs or conceptual change, and if so, which beliefs and altered in what ways? Does or must teacher learning involve the elicitation and reconstruction of practical arguments, which are *post hoc* examinations and justifications of actions (Fenstermacher & Richardson, 1993)? Or, is teacher learning the ability to perform or enact certain complex practices, such as a guided reading or writer's workshop or establishing community routines in a classroom? If so, who decides which practices? Or, is teacher learning the development of pedagogical content knowledge or specialized content knowledge *for* teaching? Or, has learning occurred when an individual has been enculturated into a community's ways of thinking? For instance, Montessori teachers and schools enact a particular curriculum and pedagogy that is based upon a philosophy of child development; teacher learning might mean coming to participate in the classroom and school (Cossentino, 2009). Legitimate participation comes with understanding how that philosophy is instantiated in the classroom and teacher communities. If learning involves enculturation, how does one respond to the multiple communities found in education? Finally, if one considers the notion of distributed cognition, has learning occurred when a community of educators knows where expertise lies and how to find and elicit that expertise in the service of resolving a dilemma of practice? For instance, when seeking to support a pupil who is struggling to read grade-level texts, the necessary expertise may reside in the child's former teachers, parents, and the district's reading specialist.

When considering the question what kind of learning counts, for many teacher educators, the likely answer is "all of the above." In the current policy climate, however, the most salient marker of teacher learning is whether new teachers positively impact pupil learning, typically as measured on achievement tests. The urgency of the accountability climate has pressed those who study teacher learning processes to build linkages, or chains of evidence, from teacher learning, to teacher practice, to pupil learning (Cochran-Smith & Fries, 2005).

Many teacher educators and researchers of teacher learning struggle with this framing of teacher learning, which they perceive as an overly narrow construal. For them the central purpose of ITP is to prepare teacher candidates to teach for understanding and equity. Teacher educators typically stand for more expansive ways of knowing and learning that enhance access to learning, particularly for those whom our schools have historically marginalized or served poorly. Several recent reviews of the literature on learning to teach were consulted to synthesize what is known about learning to teach for understanding and equity (Ball & Cohen, 1999; Borko & Putnam, 1996; Bransford et al., 2005; Calderhead, 1996; Darling-Hammond et al., 2009; Feiman-Nemser & Remillard, 1996; Kennedy, 1999b; National Research Council, 2010; Putnam & Borko, 1997; Richardson, 1996; Rosaen & Florio-Ruane, 2008; Wideen et al., 1998; Wilson et al., 2001). Not surprisingly, one obvious conclusion reached by many teacher educators is that learning to teach for understanding and equity will not be achieved by the provision of propositional knowledge (Wideen et al., 1998). In other words, both cognitive and social constructivist theories of learning have taken firm hold, leading researchers to view teacher candidates as active, social learners who must learn to perceive, interpret, and act with increasing sophistication (Resnick, 1991); however, the precise nature and content of that sophistication varies depending on one's normative or philosophical perspectives regarding the purposes of education. Thus, on the one hand, many of these scholars acknowledge that our understanding about learning to teach is fragmented, contradictory, and incomplete; on the other hand, some findings have coalesced around the respective roles prior beliefs, content knowledge, mentors and colleagues, tools, and setting play in learning to teach.

Role of Prior Beliefs

One of the most fertile areas of cognitively oriented research addressed the role of prior beliefs and knowledge in learning to teach. Several reviews summarize this body of work (e.g., Calderhead, 1996; Pajares, 1992; Putnam & Borko, 1997; Richardson, 1996). The term *belief* has a certain definitional slipperiness associated with it. Calderhead points out the range of terms used to refer to beliefs.

> The term *beliefs* has been used in research in numerous ways. As Pajares (1992) points out, such terms as beliefs, values, attitudes, judgments, opinions, ideologies, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories, personal theories, and perspectives have frequently been used almost interchangeably, and it is sometimes difficult to identify the distinguishing features of beliefs and how they are to be separated from knowledge. (Calderhead, 1996, p. 719)

Richardson (1996), drawing upon philosopher's distinctions, argues that "the term *belief* . . . describes a proposition that is accepted as generally true by the individual holding the belief. It is a psychological concept and differs from knowledge, which implies epistemic warrant" (p. 104). That is, knowledge, unlike beliefs, must meet standards of evidence and does not have varying degrees of conviction. Perhaps the slipperiness in defining this term results from the fact that may teachers treat beliefs as knowledge (Kansanen et al., 2000).

A common starting point for research into the role of prior beliefs on learning to teach has been the recognition that teacher candidates arrive in teacher preparation settings having experienced 12 to 16-plus years of formal education; Lortie (1975) called this period the "apprenticeship of observation." During this apprenticeship, individuals form robust schema that "provide a frame of reference for deciding what is appropriate or inappropriate classroom behavior" (Kennedy, 1999b, p. 56). Other sources for frames of reference include cultural/media archetypes, other personal experience that informs a world view, and experience with formal knowledge (Richardson, 1996; Wideen et al., 1998). Often, these schemas support traditional notions of direct instruction and receptive/accrual learning; as such, they guide new teachers to teach in manners consistent with how they were taught, rather than in ambitious and more equitable ways. Kennedy argues, "Reformers can change teaching practices only by changing the way teachers interpret particular situations and decide how to respond to them" (Kennedy, 1999b, p. 56). However, teacher candidates' entering beliefs have proven remarkably resilient. Thus, these schemas or beliefs are both filters of learning as well as targets of change (Borko & Putnam, 1996; Putnam & Borko, 1997; Richardson, 1996).

Scholars' inquiries into teacher beliefs have examined the characteristics of beliefs on a wide array of domains. Calderhead (1996) categorizes teachers' beliefs into the following areas: beliefs about learners and learning, teaching, subject, learning to teach, and the self and the teaching role. Borko and Putnam do not separate knowledge and beliefs, and they organize their two published reviews into a teacher candidate's knowledge and beliefs about general pedagogy (which includes beliefs about teaching, conceptions of the self and teaching, learners and learning, and classroom management), subject matter, and pedagogical subject matter. Though providing a content analysis of beliefs is helpful, what has been far more critical in this area of research is inquiry into how beliefs function as filters or frames of reference, why they are so resilient, and what relationship beliefs have with actual practice.

Studies that show how beliefs serve to filter teacher candidate learning have often been conducted in the context of programs whose purpose is to prepare teacher candidates so they understand constructivist theories of learning and will engage in practices consistent with those theories. In general, researchers have reasoned that when teacher candidates do not embrace learner-centered theories and practices, their initial beliefs about teachers and learning serve as barriers to understanding research-based theories that run counter to their beliefs. Beliefs filter teacher's perceptions, interpretations, and decisions about how to respond to particular classroom events. Most of these studies have used interpretive research designs and have tended to involve small participant populations. A few general findings now follow.

Hollingsworth (1989) found that prior beliefs influenced both how teacher candidates interacted with information presented in the ITP program and more importantly with the depth of conceptual change. Hollingsworth conducted baseline interviews and observations to develop background profiles. Multiple data sources were collected, including audiotapes of teacher education courses, completed assignments and journals, systematic interviews, and observation of the teacher candidate's classroom teaching. Taxonomies of cognitive processing, for example, Rumelhart and Norman's (1976) categories of accretion, fine-tuning, and restructuring were used to code the data and to determine cognitive change. Data were reduced into a case study of each participant. Cross-case analysis allowed Hollingsworth to show how beliefs about general classroom management, the teaching of reading, and of the academic task changed over in response to experiences in the teacher preparation program. Using inductive methods, Britzman (2003) conducted extensive interviews and observations of two individuals to show that beliefs have a high level of specificity. The Teacher Education and Learning to Teach study, TELT, found that belief systems, or frames of reference, depended on a particular situation. Indeed, in this study of writing instruction, the closer the teachers moved to actual practice, the more their frame of reference reflected a traditional view of writing instruction (Kennedy, 1999b).

A number of scholars have speculated on why teacher candidates' initial beliefs have proven to be so resilient. Frequently cited, Weinstein's (1989, 1990) studies involving questionnaires, interviews, and self-rating scales found that teacher candidate's were unrealistically optimistic about the difficulties teaching would pose for them. Weinstein speculates that such a stance may have given teacher candidates little motivation to engage in concepts introduced by teacher educators. Kennedy (1998) argues that most teacher's beliefs fall into the "difficult-to-change" category, for example, formed early in life, containing an affective component, related to self-concept, and interconnected with other beliefs. Many have commented on the apparent disconnect between the agenda of teacher educators and that of teacher candidates (e.g., McDiarmid, 1990; Zeichner & Gore, 1990). That is, teacher candidates enter teaching with a strong belief that the teacher's role is to present knowledge to students; meanwhile, teacher educators seek to prepare them to view teaching as guiding students to construct understanding. Wideen and his colleagues (1998) press teacher educators to question this fundamental tension by engaging in a critical examination of teacher educators' beliefs and normative views regarding the purposes of teacher education. Accompanying such an examination would be efforts on the part of teacher educators to understand, from the teacher candidates' perspective, why it is that teacher candidates' ideas about teaching make sense to them. Such inquiry might parallel studies like Ball and Wilson (1996) have conducted in examining young children's misconceptions regarding core concepts in math and social studies; rather than view the children's thinking as errors, Ball and Wilson take their students' ideas seriously and view their misconceptions as genuine attempts to make sense of new ideas.

Wideen et al. (1998) review a number of short- and long-term interventions designed to promote changes in beliefs, or conceptual change. Short-term interventions include specific courses, such as introductory seminars or content area methods courses, while long-term interventions spanned at least a full year and tended to reflect program-level orientations. Across these studies, a range of specific beliefs were examined, for example, beliefs about diverse students, conceptions of the subject matter, role of the teacher. Many of the findings were based on inductive analyses of extensive interview data, artifact analysis, and observation in both university courses and in field settings. Wideen and colleagues claim that no conclusive findings emerge from this set of studies. One general trend is that studies seeking to document noticeable change within the context of one course have more often been less effective than longer-term interventions (Richardson, 1996; Wideen et al., 1998), thus suggesting that beliefs that have been constructed over long periods of time may not be so easily reconstructed in one experience within an ITP program. Wideen and colleagues (1998) conclude that those ITP programs that "build upon the beliefs of preservice teachers and feature systematic and consistent long-term support in a collaborative setting" are more successful in promoting genuine conceptual change (p. 130). Feiman-Nemser and Remillard (1996) name several basic conditions for bringing about conceptual change: opportunities to evaluate positively new practices when compared to traditional ones, opportunities to see examples of new practices in authentic settings, if possible, and direct experiences, as learners, when these approaches are enacted.

More longitudinal studies that carefully examine the arc of teacher learning from ITP through induction may be needed to fully understand changing belief systems and by extension teaching practices. Wideen et al. (1998) suggest that the “fixed nature of prospective teachers’ beliefs should remain an open question rather than an accepted assumption until the impact of the more robust programs of teacher education has been fully analyzed” (p. 144). Robust, in this case, implies those programs that meet the conditions suggested in the previous paragraph. In many of these interpretive studies, though researchers characterize the nature and degree of conceptual change, there is no common metric for change. Thus, the ambiguous results of preservice teacher change may well reflect the researchers’ normative biases regarding how much change “counts” as significant growth or development. One way researchers can respond is by providing detailed descriptions of data analysis. Adams and Krockover (1997) suggest an exemplar to guide future study designs.

Continued attention to beliefs will prevail as long as beliefs are psychologically found to interact with practice. While Calderhead (1996) holds that relationships between beliefs and classroom practice are “contestable,” Richardson’s (1996) review concludes that the relationship between beliefs and action is indeed complex and reciprocal; that is, not only do beliefs “drive” action, but also reflection upon action may change beliefs. The two “operate together in praxis” (Richardson, 1996, p. 105). What is still unclear, at least empirically, is whether changed beliefs will necessarily lead to changes in practice. Findings from the TELT study suggest that what a teacher espouses generally about her teaching practice is not necessarily consistent with how she decides to respond to a particular teaching situation (Kennedy, 1998). Wilcox, Schram, Lappan, and Lanier (1991) found that although experiences in a constructivist teacher education program led elementary teacher candidates to change beliefs about how they, as adults, learned math, their beliefs about how children learn mathematics did not change, remaining consistent with traditional, prescriptive views of math instruction. The methods used in the TELT study suggest that beliefs must be determined in the context of particular tasks, thus reflecting a situative perspective. The context plays a role not only in the ability of the teacher candidate to change her beliefs, but also in her ability to have her practices align with her beliefs. For example, in the mathematics example just provided, the researchers speculate that some reasons for the discrepancy between beliefs about personal learning and beliefs about children’s learning may be the result of the heavy reinforcement of traditional pedagogy during student teaching and initial years of teaching.

Much of the above discussion has focused on our understanding of the ways that beliefs about teaching and the teacher’s role help explain why new teachers do not readily take up the ambitious ideas and practices of teaching for understanding. As important, is research illustrating how candidate’s “sociocultural consciousness” shapes their ability to understand students whose linguistic and cultural backgrounds differ from theirs and to engage in culturally responsive teaching practices (Banks et al., 2005). Teachers’ ability to see and build on assets students bring shapes how they conduct daily interactions, establish classroom rituals and routines, make curricular choice, scaffold learning, and, as a result, engage their students and give them access to content. Yet, teacher’s unexamined deficit beliefs about nonmainstream students—that is, those living in poverty-impacted communities and/or who come from culturally and linguistically diverse backgrounds—often lead to lowered expectations for nonmainstream students, new teacher’s unwillingness to engage productively in discussions of race and class in the classroom, and/or new teacher’s inability to support emerging bilingual students use their first/home language as a resource to access academic content and to acquire full fluency in the English language (Hollins & Torres-Guzman, 2005; Lucas & Grinberg, 2008; Sleeter, 2008; Villegas, 2007).

The resounding conclusion is that prior beliefs do shape teacher candidate’s learning, serving variously as “filters,” “frames,” “barriers,” or perhaps “gatekeepers” to understanding culturally responsive, learning centered theories and practices. Furthermore, because beliefs are so salient, many teacher educators view them as targets of change, and thus an important objective of ITP is to shift teacher candidate’s frame of reference for teaching and learning. Unfortunately, many teacher candidates do not expect that teacher preparation will involve changing frames of reference. Rather, they expect teacher preparation will show them how to teach, that is, provide them with the procedures of traditional practice; hence they resist teacher educator’s ideas. There is, then, a normative tug of war between teacher candidate’s expectations and teacher educator’s objectives in ITP. Cognitive psychology might help resolve this clash by providing more nuanced understandings of the exact mechanisms by which these “filters” or “frames” operate. While some studies indicate that the characteristics of the individual do indeed matter, less well understood is how the substance of the belief itself shapes interpretation. For instance, do beliefs about race or class matters work differently than those about subject matter? What emotions are associated with the beliefs and with the experience of dissonance, and how do those emotions shape the learning/unlearning experience? Motivation theory may contribute insights into how individuals choose to mediate significant dissonance. How do relationships among teacher educators and candidates, and among teacher candidates shape the process of conceptual change? Findings in other chapters in this volume (see Pintrich, this volume; Sabol & Pianta, this volume) may also inform teacher educator's practice and research. Finally, a situative perspective holds great promise, for empirical evidence suggests that belief systems, or frames of reference, are highly dependent on specific task situations and contexts.

Role of Subject Matter Knowledge and Pedagogical Content Knowledge

Shulman's identification of content as the "missing paradigm" launched a number of studies into how teacher candidates' prior understanding of subject matter shapes learning to teach. Some of this research falls within the larger framework of research on teacher beliefs; that is, studies examined how teacher candidate's conceptions of the subject matter, both as an academic discipline and as a school subject, play a role in learning how to teach. Other studies explored the relationship between the teacher candidate's formal knowledge of the subject matter and learning to teach specific content and concepts. Schwab's (1964) distinction between the substance and syntax of a discipline often appears in discussions of teacher's subject matter content knowledge. Researchers have analyzed teacher's knowledge in terms of what they know about how the core concepts, ideas, and facts of a discipline are organized and relate to one another (substance) as well as what they know about the system of evidence by which inquiry is conducted within the discipline and by which new knowledge is added (syntax). As it turns out, what a teacher candidate knows shapes both the content and methods of a teacher's practice (Borko & Putnam, 1996). A number of in-depth research reviews have yielded several core findings (Floden & Meniketti, 2005; Putnam & Borko, 1997; Richardson, 1996; Wilson et al., 2001).

First, with regard to the substance of teacher candidates' subject matter content knowledge, teacher candidates have often "mastered basic skills, but they lack the deeper conceptual understandings that is necessary when responding to student questions and extending lessons beyond the basics" (Wilson et al., 2001, p. 9). This finding stretches across all the academic disciplines and has been documented at the level of specific substantive, core subject matter concepts, for example, understanding place value and fractions in mathematics (Ball, 1990). Teacher candidates' syntactic knowledge has been shown to have great variation (Grossman et al., 1989). For those interested in novice teachers' understanding of math and science, the evidence suggests that most teacher candidates do not have a deep grasp of the discipline's epistemology (Borko & Putnam, 1996). Second, those teachers who "have richer understanding of subject matter tend to emphasize conceptual, problem-solving, and inquiry aspects of their subjects, whereas less knowledgeable teachers tend to emphasize facts and procedures" (Putnam & Borko, 1997, p. 1232). These findings are significant because teachers without this robust understanding of substance and syntax of the discipline are more likely to teach uncritically those lesson plans taken from textbooks and colleagues and to miss opportunities to clarify and extend student's understandings of subject matter knowledge. Third, the empirical evidence is mixed with regard to whether or not teacher candidates can develop deeper understandings of a discipline or beliefs about the nature of the discipline during ITP. It appears that when teacher candidates have opportunities to engage in solving real problems, work in small groups, and to talk about their learning, they are more likely to improve their substantive content knowledge (Borko & Putnam, 1996). Finally, a number of studies were reviewed by Wilson and colleagues (2001) to examine the relationship between subject matter knowledge and student learning. Interestingly, they identified no rigorous research that examined directly these two factors; rather, most studies used proxies for subject matter knowledge—for example, specific courses or academic majors. Indicators of student learning were often reduced to standardized test scores, which many argue is an inadequate way to assess the kind of understanding promoted in many of the reforms. The few studies meeting their criteria reveal inconclusively how, specifically, teachers' subject matter knowledge matters in shaping children's learning.

Related to inquiries into the role of subject matter content knowledge in learning to teach have been numerous studies about the how teacher candidates develop pedagogical content knowledge. This form of knowledge has received much attention because it is arguably unique to teaching; furthermore, since few teacher candidates have well-developed pedagogical content knowledge when they begin teacher preparation programs, this domain of teacher knowledge must be developed within the purview of teacher preparation or during the induction phase of learning to teach. Most research reviews cite Grossman's (1990) landmark study when defining the key components of pedagogical content knowledge (see previous section on cognitive constructivist perspectives, where these components were outlined).

Again, the team of Borko and Putnam (1996, 1997) provide a thorough synthesis of research into all four components of Grossman's conceptualization. Several key findings emerge from the studies they review. First, the teacher candidate's conception of the discipline directly influences instructional choices, resulting in dramatically different classroom experiences for learners, even when the basic content is the same. For example, Grossman (1990) showed that two high school teachers' conception of teaching English dramatically shaped the way they taught *Hamlet*. One teacher emphasized close textual reading of the entire play, while another used film versions as the "text." These different emphases stemmed, in part, from the teachers' different views about the purpose of high school English. One sought to introduce her students to the norms of literary criticism practiced in university English departments, while the other viewed high school English as an opportunity for students' to forge personal connections between cultural works of merit and their lived experience. These conceptions of subject matter function much like beliefs do, and thus are not easily changed. However, several rigorous studies have demonstrated that teacher preparation courses can help teacher candidates reconstruct their subject matter knowledge into a conception of the discipline that is better suited for student learners. For example, Gess-Newsome and Lederman (1993) worked with preservice biology teachers. Initially, these teachers were only able to generate discrete topical lists of core biology topics; however, over the science methods course, the teachers were able to transform this topical list into one that established interconnections among topics. Thus, this experience influenced the organization of their knowledge of biology as a school subject matter. A second finding is that if a teacher candidate's subject matter content knowledge is weak, then accordingly, his/her pedagogical content knowledge will also be weak. This has interesting implications for the design of baccalaureate teacher preparation programs in particular, where the likelihood of working more closely with liberal arts/science faculty is higher than in postbaccalaureate programs. It raises the question of whether it is possible to develop simultaneously subject matter content knowledge and pedagogical content knowledge. A third finding is that one of the great challenges for teacher candidates is to learn when children are likely to encounter confusion and difficulty in learning content. Much of the research has pointed out what teacher candidates do not know about student's understanding. Such knowledge is particularly important with a more diverse student population, particularly when diverse teachers have little insight into how cultural and linguistic background knowledge frame their students' grasp of academic content.

Role of Mentors and Colleagues

Sociocultural and situative perspectives on learning illustrate the importance of cognitive apprenticeship (Brown et al., 1989), assisted performance (Tharp & Gallimore, 1988), and mediated praxis (Gutierrez & Vossoughi, 2010). Research from this perspective pays special attention to the critical role that dialogue with others plays in the process of learning to teach. Teacher educators and teacher candidates both recognize that conversations with mentors, both cooperating teachers and university supervisors, and with colleagues are a means for teacher candidates to mediate their understanding of the knowledge base for teaching and to refine their judgments and decisions (Cochran-Smith & Lytle, 1999). Talk with parents is also a potentially rich source of learning for teacher candidates. Potentially educative conversations occur both formally (e.g., through planning or evaluation conferences and through class activities and assignments) and informally (e.g., through voluntary associations, cohort groups, and in communities of practice such as those found in professional development schools). Many of the studies cited earlier in this chapter regarding conceptual change or changing content knowledge did in fact involve "interventions" that placed teacher candidates in small, problem-solving groups or learning communities.

Much of the foundational work about the role colleagues play in mediating experience has analyzed discourse occurring in innovative communities of experienced teachers (Wilson & Berne, 1999). Descriptive analyses have provided "existence proofs" of such communities (e.g., Goldenberg & Gallimore, 1991; Sherin, 2000; Wineburg & Grossman, 1998) and of the importance of professional cultures that integrate novices and veterans (Johnson & the Project on the Next Generation of Teachers, 2004). Studies of teaching learning in the initial years of teaching, particularly in the context of formal induction partner relationships, have helped us understand aspects of "educative mentoring" (Feiman-Nemser, 2001b; Katz & Feiman-Nemser, 2004). Across these different communities of practice, researchers have identified critical features of collaborative spaces that foster robust teacher learning. For example, whether or not a mentor/inductee dyad or community has an inquiry stance may play a role in the substance and depth of learning (Cochran-Smith & Lytle, 1999). The role that conflict plays in the learning process is potentially an important variable. For example, conflict is often perceived as something to avoid, when the dissonance may well be essential for deep learning (Achinstein, 2002; Sapon-Shevin & Chandler-Olcott, 2001). Teacher candidates may need to learn how to engage in constructive argument, a practice that runs counter to the norms of privacy, politeness, and nonjudgmental interactions found in most school's faculty communities (Wilson & Berne, 1999). This seems especially important if teachers are going to discuss the genuine challenges associated with understanding how matters of ethnicity, class, and gender shape children's learning. Focusing the talk upon artifacts of teaching (e.g., student work or video tapes of classroom events) seems to lead to more focused interactions where participants wrestle with the learner's understanding (Allen, 1998; Sherin, 2000). Factors that may influence the quality of talk and, by extension, learning include: an individual's role and authority within the group (group refers to two or more participants); the purposes and protocols for conversation; the length of time that the group has existed; the stability of membership in the group; the presence or absence of a facilitator who scaffolds discussion; and the rewards for participation in the group.

Role of Tools That Mediate Learning

Sociocultural views of learning also make explicit how tools—both conceptual and practical—mediate learning to teach. These are tools teachers use to carry out the work of teaching and learning to teach. Grossman and her colleagues explain the two types of tools, using the English language arts as a context:

> Conceptual tools are principles, frameworks, and ideas about teaching, learning, and English/language arts acquisition that teachers use as heuristics to guide decisions about teaching and learning. Conceptual tools can include broadly applicable theories such as constructivism or reader-response theory, and theoretical principles and concepts, such as instructional scaffolding, that can serve as guidelines for instructional practice across the different strands of the curriculum . . . Practical tools are classroom strategies and resources that do not serve as broad conceptions to guide an array of decisions, but instead, have more local and immediate utility. These include instructional practices, such as journal writing and daily oral language exercises, and resources such as textbook and curriculum materials that provide such instructional practices. (Grossman, Smagorinsky, & Valencia, 1999, p. 15)

Two empirical studies illustrate how researchers have examined closely features and use of specific tools to understand learning to teach. Grossman and Thompson study how new teachers encounter and engage with curriculum materials in their initial years of teaching. They examine how the materials function to shape both new teacher's ideas about teaching English and their specific classroom practice (Grossman & Thompson, 2008). They trace subtle developmental shifts in how novice teachers take up curricular materials and demonstrate that features of curriculum materials can be both more and less educative for new teachers. Windshitl and his colleagues used a system of tools comprising both rubrics and protocols to guide novice teacher's discussions of pupil work (Windshitl, Thompson, & Braaten, 2011). The recursive use of tools in this multiyear, multicase study helped some teachers develop accomplished classroom practices early in their careers; but they also found that learning with and from these tools varied largely based on whether teachers entered the experience with problematized or simplified conceptions of teaching and learning. The appeal of examining both tools and tool-based routines is that these are resources teacher educators employ to parse and make available the work of teaching and to organize discourse among teacher candidates: Analyzing their affordances and constraints to guide learning is a fruitful line of inquiry in understanding learning to teach.

Role of Settings for Learning

Finally, as a situative perspective takes hold, it has framed settings, or contexts, as central to the learning process. But, as Putnam and Borko ask, "Where should teachers' learning be situated?" (2000, p. 5). Many teacher candidates and practicing teachers hold that field experiences are the *sine qua non* of settings in which teacher candidates learn to teach; however, several reviews summarize research enumerating many well-recognized flaws of these experiences, for example, disconnected from other components of teacher preparation, focused narrowly on mechanical aspects of teaching, reinforcing the status quo of traditional teaching, and overwhelming thus leading teacher candidates to teach in ways they were taught (Boyle-Baise & McIntyre, 2008; Clift & Brady, 2005;

Wilson et al., 2001). Much of the conceptualization of professional development schools seeks to overcome these flaws (Darling-Hammond, Wise, & Klein, 1999; Sirotnik & Goodlad, 1988). Gallego (2001) describes a novel blending of field experiences completed in both classroom and community-based settings in order to foster understanding of the complex relationships that support teaching and learning. For example, the field experiences in two settings provided a productive contrast so that the teacher candidates were able to recognize and critically reflect upon the role that physical environment plays upon ownership of learning. Zeichner (2010) argues for "hybrid spaces . . . where academic and practitioner knowledge and knowledge that exists in communities come together in new less hierarchical ways in the service of teacher learning" (p. 79). Gutierrez and Vossoughi (2010) make an empirical case for transformative learning that occurs when candidates work in robustly designed learning ecologies. They illustrate one apprentice teacher's social and cognitive shifts and the ways in which the activity system afforded this beginning teacher opportunities and support to develop a more expansive view of learning. Some of the most cutting-edge work in teacher education occurs when communities, apprentice and practicing teachers, and teacher educators engage collaboratively to design activity systems where all participants (children to adults) have opportunities to develop new ways of participating in learning practices and by extension sense-making processes. This work reimagines where and how the work of learning to teach occurs.

Three Integrative Models of Learning to Teach

As stated at the start of this section, the heart of learning to teach is the development of judgment, which involves the acquisition and integration of various forms and domains of knowledge to guide action for particular purposes in specific social and cultural contexts. The aim of initial teacher education is to prepare "well-started novices" who are launched on a pathway toward being an accomplished teacher who engages in principled practice. An accomplished teacher has a well-developed pedagogical vision, perceives subtle nuances in learning situations, has a robust and efficient pedagogical repertoire, maintains an inquiry-oriented stance, and invokes principles to guide action in new settings or situations. The previous sections of have explored the roles beliefs, understanding of content, mentors/colleagues, tools/tool-based routines, and activity settings play in the processes of learning to teach, thereby suggesting that learning to teach may be parsed into discrete elements; in actuality, however, teaching and learning teaching is a delightfully messy endeavor. Three models provide theoretical foundations to describe learning to teach in a more integrative fashion. What cuts across all three integrative models is a quest to describe the mechanisms by which teachers achieve mastery or expertise as they navigate highly contextualized teaching and learning situations.

Adaptive Expertise

The first is "adaptive expertise," a model that draws attention to learning over time. Developed by Japanese scholar Hatano, the notion of adaptive expertise emerges out of comparisons between routine and adaptive experts (Hatano & Inagaki, 1986; Hatano & Oura, 2003). Bransford and colleagues (2005) distill this distinction:

> Routine experts develop a core set of competencies that they apply throughout their lives with greater and greater efficiency. In contrast, adaptive experts are much more likely to change their core competencies and continually expand the breadth and depth of their expertise. This restructuring of core ideas, beliefs, and competencies may reduce their efficiency in the short run but make them more flexible in the long run. These processes of restructuring often have emotional consequences that accompany realizations that cherished beliefs and practices need to be changed. (pp. 48–49)

The adaptive expert is one who astutely balances innovation (exploring new or inventive practices) with efficiency (implementing well-practiced routines) because she remains open and willing to change core competencies as the situation calls for over time. The conceptualization of adaptive expertise acknowledges that learning occurs through a "restructuring" process and recognizes the emotional intensity that often attends such restructuring. Given the uncertainty and complexity of teaching, the image of the adaptive expert is desirable as it implies a commitment to life-long, deep learning and a trajectory from novice to expert.

Gestalt-Schema-Theory: A Three-Level Model

The second is Dutch researcher Fred Khortagen's "three-level model," which offers a theoretical foundation for the Dutch "realistic approach" to teacher education (Khortagen, 2010; Khortagen, Kessels, Koster, Wubbels, & Lagerwerf, 2001). This approach seeks to provide an explanation for how knowledge acquisition occurs in the context of concrete teaching experiences and to offer a mechanism by which teachers develop more expert, theoretically grounded understandings from experience. The model describes three levels—gestalt, schema, and theory. The first of the three levels is described as the "gestalt" level. A gestalt "encompasses the whole of teacher's perception of the here-and-now" situation, that is, both his or her sensory perception of the environment as well as the images, thoughts, feelings, needs, values, and behavioral tendencies elicited by the situation'' (p. 101). When a teacher encounters a new or puzzling experience in the classroom, for example, gestalts are unconscious, intuitive, highly contextualized understandings of a situation that guide his or her reactions and actions.

When a teacher notices something has gone awry and begins to seek out explanations for how to act, he or she becomes consciously aware of cognitive schema(s). Or, as Khortagen explains, "When an actor reflects on a situation and the actions taken in it, and perhaps also on other similar situations, he or she may develop a conscious network of concepts, characteristics, principles, and so on, helpful in describing practice. Such a mental network is called a schema, and the development of such a schema is an important next level in the learning process" (p. 102). The schema involved is a form of "situated generalization."

As a detailed and rich schema develops, the teacher may feel the need to bring order to the complexity of the schema, or to move to the theory level. At this third level, the teacher develops a "deep and generalized understanding of a variety of similar situations" (p. 103). After reaching the theory-level, a "level reduction" may occur. That is, "after some time, schematized or even theoretical knowledge can become self-evident, and the schema or theory can be used in a less conscious way. It is as if the whole schema or theory has been reduced to one gestalt" (p. 103). This three-level model provides an explanation for how theory emerges out of experiences, and the process of "level reduction" helps explain how accomplished teachers engage in principled practice.

Activity Theory: Learning as Appropriation

A third model to illuminate processes of learning to teach is activity theory (Grossman et al., 1999): "A central concern of activity theory is to understand the kinds of culturally defined futures that motivate people's activity and sorts of tools they develop in order to help one another mediate one another's progress toward those futures" (p. 5). Thus, an activity theory framework draws attention to activity settings, identity, and tool—concepts elaborated above. Activity theory explains learning as a process of "appropriation."

> Appropriation is the process through which a person adopts the pedagogical tools available for use in particular social environments (e.g., schools, preservice programs) and through this process internalizes ways of thinking endemic to specific cultural practices (e.g., using phonics to teach reading). Through the process of appropriation learners reconstruct the knowledge they are internalizing, thus transforming both their conception of the knowledge and that knowledge as it is construed and used by others (Grossman et al., 1999, p. 5).

Of particular interest in activity theory are the descriptive levels of appropriation, as these prove helpful in characterizing depth of learning that occurs in the context of initial teacher preparation. Grossman and colleagues provide a succinct distillation of these levels. The first level is a *lack of appropriation*, which may stem from a lack of understanding or an explicit decision to reject an idea or tool. The second involves *appropriating a label*, "when a person learns the name of tool but knows none of its features" (p. 16). Third involves *appropriating surface features*, which entails understanding features discretely, rather than a conceptual whole. Fourth is *appropriating conceptual underpinnings*, or the point at which teachers grasp the "conceptual underpinnings of a tool and are likely to make use of it in new contexts and for solving new problems" (p. 17). Fifth and final is *achieving mastery*, which is the ability to use a tool effectively. Activity theory has a great deal of explanatory power because it describes and accounts for teacher learning in a systemic way.

Summary of Learning to Teach

What emerges from this necessarily partial summary of studies of learning to teach is that if the central goal of ITP is to ensure those teachers entering the profession are able to teach for understanding and equity in classrooms serving culturally and linguistically diverse learners, then teacher educators must support new teacher candidates to develop new frames of reference and enactments that are consistent with these ideas (Kennedy, 1998, 1999b). This has, thus far, proven difficult to accomplish on a widespread basis. The set of beliefs about teaching and learning that candidates have constructed over many years as learners in classrooms and their often-limited cross-cultural experiences prove to be quite resilient and powerful filters that guide their interpretations of experiences in ITP. For many teacher candidates, ITP aims to create occasions to develop a wholly new, and often contradictory, view of accomplished teaching and powerful teaching practices. For new teachers to enact these reform-minded practices requires not only new beliefs about teaching and learning, but also the ability to transform substantive content knowledge into pedagogical content knowledge. Like changing beliefs, this has also proven difficult to do. Rigorous studies that have been conducted yield contradictory results. Fortunately, theoretically driven models of teacher learning and reform in both the tools and the settings in which teacher candidates learn to teach have led to powerful arguments for and experiments in redesigning the experiences, tasks, and settings through which teacher candidates learn to teach. For example, researcher's attention to talk in the learning process and to the influence of context in the learning process has potential to illuminate some vexing dilemmas of learning to teach. Scholars in this field are just beginning to understand and evaluate the nature of learning that occurs in these newer frameworks.

PEDAGOGICAL PRACTICES IN INITIAL TEACHER PREPARATION

Much of the above research has both obvious and subtle implications for pedagogy in ITP. The image of accomplished teaching shared among teacher educators, captured in the umbrella term *teaching for understanding and equity*, often runs counter to both teacher candidate's prior beliefs about teaching and the culture and common practices found in many schools. ITP, then, must offer a strong "intervention" in order to bring about robust learning (or unlearning?). Many see teacher preparation as a relatively weak intervention, poised between these far more enduring learning experiences (Richardson, 1996). Recent innovations in teacher preparation—including building a professional curriculum around "high-leverage" practices (Ball et al., 2009) or developing "robust learning ecologies" (Gutierrez & Vossoughi, 2010) suggest promising directions for the curriculum and contexts that will provoke learning that is not washed out in the initial years of teaching.

In addition, attention to the pedagogy of teacher education (Grossman, 2005; Grossman, Compton, et al., 2009; Grossman, Hammerness, et al., 2009) offers a line of inquiry into a critical feature of initial teacher preparation. Grossman's (2005) historical review of research on the pedagogy of professional education delves into a number of practices including micro-teaching and laboratory experiences, computer simulations, use of video and hypermedia, case methods, portfolios/performance assessments, and practitioner research. A framework that might productively organize these different learning activities is to consider four pedagogical moves typically found in initial teacher preparation programs: pedagogies of noticing (Sherin, Jacobs, & Philipp, 2011), pedagogies of reflection, pedagogies of investigation, and pedagogies of enactment (Grossman, Hammerness, et al., 2009). Because pedagogies of reflection (e.g., journals or case writing, intellectual autobiography, family educational biographies, portfolio commentaries, video elicitation) and pedagogies of investigation (e.g., child or adolescent case study, action research projects, community studies) are more familiar, the remainder of this section considers briefly pedagogies of noticing and enactment. While on the one hand noticing is an everyday term, on the other hand noticing in ITP refers to the intellectual work involved in attending to and make sense of particular classroom events. With the rise of video as a way to represent and archive actual classroom practice, there has been a concomitant development of pedagogies of noticing that guide teachers to view classroom situations in increasingly more nuanced, subtle ways and to link those observations to evidence-based claims about both what is occurring and plausible explanations for why. The use of observation protocols, walk-throughs, and grand rounds might also be considered examples of a pedagogy of noticing. Pedagogies of enactment draw attention to how teacher educators offer representations of practice, decompose practice into manageable steps, and opportunities for rehearsal with timely, specific feedback loops. Grossman's study of professional education in several arenas outside of teaching (e.g., ministry and law) offers the field a well-conceived argument for developing our collective repertoire in this area.

Inquiry into the pedagogy of teacher education, particularly when the learning environment has been intentionally designed to support beginning teacher learning, helps the field build a chain of evidence that links teachers with experiences in teacher preparation with practices in their own classrooms with student learning. The painstaking building of this complex chain of evidence, one well-designed study at a time, is a reasonable strategy to pursue in times when cries grow shrill for university-based teacher education to improve the overall quality of the teachers it graduates.

CONCLUSION: THE PROMISE OF SITUATIVE PERSPECTIVES TO STUDY LEARNING TO TEACH

In Berliner and Calfee's conclusion to the *Handbook of Educational Psychology* (1996), they predict "research flowing from situationist perspectives, concepts of distributed cognition, the development of new technologies, and methodologies such as design experiments, should keep educational psychologists quite busy as we enter the twenty-first century" (p. 1021). Putnam and Borko (2000) pick up on this foreshadowing, as they argue that a situative perspective brings important conceptual tools to bear on the process of learning to teach. This perspective radically reconsiders what it means to learn to teach, for it breaks down the conventional notion of first understanding a principle and then applying it in practice. Instead, a situative perspective suggests that professional knowledge, which often fuses principles and practices, is intimately connected to the contexts and settings in which individuals encounter principles and practices. In the first decade of the 21st century, scholars of learning to teach explored the explanatory power of this perspective along with its potential to guide cycles of design and research in ITP.

This cursory review of research about learning to teach has underscored the intellectual complexity of teaching. Sociocultural or situative approaches show promise in responding to ongoing questions and dilemmas about how it is that teacher candidates learn to teach and how ITP programs can best foster such learning. Thus far, scholarship in the area of learning to teach has provided several approaches to a knowledge base for teaching. This knowledge base, has in turn, shaped the substance of ITP curriculum. However, sociocultural theories of learning posit the "idea that teacher learning ought not to be bound and *delivered* but rather *activated*. This positions the 'what' of teacher knowledge in a much different place" (Wilson & Berne, 1999, p. 194). Given that teaching involves, at its core, professional judgment, emphasis on helping new teachers perceive, interpret, and respond wisely to classroom events has garnered the attention of teacher educators. Much research has been conducted examining how a teacher candidate's prior beliefs, life history, and subject matter knowledge shape interpretations of events and decisions for action. Significant emphasis has gone in to finding ways to facilitate meaningful conceptual change, with the hope that this will lead to reform-minded, culturally responsive teaching practice. The track record has been uneven. Some well-structured interventions have shown modest success at facilitating conceptual change and at fostering critical reflection, but much of this research has not necessarily connected changes in teacher thinking with desired teacher actions. Over the first 10 years of the 21st century, however, as a situative perspective came to dominate inquiry about beginning teacher learning, new and critical variables emerged that have helped develop more robust theories of learning to teach.

In closing, the body of research on learning to teach, though still relatively new, has led to understandings of the knowledge base for teaching, the critical role that prior beliefs play in teacher learning, and the powerful role that talk, tools, and settings play in the process of learning to teach. Given the ambitious goal many reformers have of ensuring that *every* child has a teacher capable of fostering deep, flexible understanding of content, scholars of learning to teach have considerable work to do. Fortunately, as we settle into the 21st century, the field appears armed with promising conceptual and pedagogical tools that have potential to provide important theoretical models of teacher learning. With rigorous research from multiple methodological traditions those models will be developed in concert with best practices for initial teacher preparation.

REFERENCES

Adams, P. E., & Krockover, G. H. (1997). Beginning science teacher cognition and its origins in the preservice science teacher program. *Journal of Research in Science Teaching, 34,* 633–653.

Allen, D. (1998). *Assessing student learning: From grading to understanding*. New York, NY: Teachers College Press.

Anderson, L. M. (1989). Learners and learning. In M. C. Reynolds (Ed.), *Knowledge base for the beginning teacher* (pp. 85–99). Oxford, UK: Pergamon Press.

Achinstein, B. (2002). *The ties that blind*. New York, NY: Teachers College Press.

Achinstein, B., & Aguierre, J. (2008). Cultural match or culturally suspect: How new teachers of color negotiate sociocultural challenges in the classroom. *Teachers College Record, 110*(8), 105–1540.

Ball, A., & Tyson, C. (Eds.). (2010). *Studying diversity in teacher education*. Washington, DC: Rowman & Littlefield and American Educational Research Association.

Ball, D. L. (1990). The mathematical understandings that prospective teachers bring to teacher education. *Elementary School Journal, 90,* 449–466.

Ball, D. L., & Bass, H. (2003). Toward a practice-based theory of mathematical knowledge for teaching. In B. Davis & E. Simmt (Eds.), *Proceedings of the 2012 annual meeting of the Canadian mathematics education study group* (pp. 3–14). Edmonton, Canada: CMESG/GCEDM.

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3–32). San Francisco, CA: Jossey-Bass.

Ball, D., & Forzani, F. (2009). The work of teaching and the challenge for teacher education. *Journal of Teacher Education, 60*(5), 497–511.

Ball, D. L., Sleep, L., Boerst, T. A., & Bass, H. (2009). Combining the development of practice and the practice of development in teacher education. *Elementary School Journal, 109*(5), 458–474.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5), 389–407.

Ball, D. L., & Wilson, S. M. (1996). Integrity in teaching: Recognizing the fusion of the moral and intellectual. *American Educational Research Journal, 33*, 155–192.

Banks, J., Cochran-Smith, M., Moll, L., Richert, A., Zeichner, K., LePage, P., . . . McDonald, M. (2005). Teaching diverse learners. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 232–274). San Francisco, CA: Jossey-Bass.

Berliner, D. C., & Calfee, R. C. (Eds.). (1996). *Handbook of educational psychology.* New York, NY: Macmillan.

Biddle, B. J., Good, T. L., Goodson, I. F. (1997). *International handbook of teachers and teaching*. Dordrecht, The Netherlands: Kluwer.

Blumenfeld, P. C., Marx, R. W., Patrick, H., Krajcik, J., & Soloway, E. (1997). Teaching for understanding. In B. J. Biddle, T. L. Good, & I. F. Goodson (Eds.), *International handbook of teachers and teaching* (Vol. II, pp. 819–878). Dordrecht, The Netherlands: Kluwer.

Borko, H., & Putnam, R. (1996). Learning to teach. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 673–708). New York, NY: Macmillan.

Borko, H., Whitcomb, J., & Byrnes, K. (2008). Research genres in teacher education. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 1017–1049). New York, NY: Routledge.

Boyle-Baise, M., & McIntyre, D. J. (2008). What kind of experience? Preparing teachers in PDS or community settings. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.) *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 307–329). New York, NY: Routledge.

Bransford, J., Derry, S., Berliner, D., & Hammerness, K. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 40–87). San Francisco, CA: Jossey-Bass.

Britzman, D. P. (2003). *Practice makes practice*. New York: State University of New York Press.

Brophy, J., & Good, T. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 328–375). New York, NY: Macmillan.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32–42.

Bruner, J. (1960). *The process of education*. Cambridge, MA: Harvard University Press.

Buchmann, M., & Floden, R. (1993). *Detachment and concern: Conversations in the philosophy of teaching and teacher education*. New York, NY: Teachers College.

Calderhead, J. (1996). Teachers: Beliefs and knowledge. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 709–725). New York, NY: Macmillan.

Carter, K. (1990). Teachers' knowledge and learning to teach. In W. R. Houston (Ed.), *Handbook of research on teacher education*. New York, NY: Macmillan.

Carter, K., & Anders, D. (1996). Program pedagogy. In F. B. Murray (Ed.), *The teacher educator's handbook: Building a knowledge base for the preparation of teachers* (pp. 557–592). San Francisco, CA: Jossey-Bass.

Carter, K., & Doyle, W. (1996). Personal narrative and life history in learning to teach. In J. Sikula, T. Buttery, & E. Gutor (Eds.), *Handbook of research in teacher education* (2nd ed., pp. 120–142). New York: NY: Macmillan.

Clandinin, D. J., & Connelly, F. M. (1987). Teachers' personal knowledge: What counts as "personal" in studies of the personal. *Journal of Curriculum Studies, 19,* 487–500.

Clark, C. (1995). *Thoughtful teaching*. New York, NY: Teachers College.

Clark, C., & Peterson, P. (1986). Teachers' thought processes. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 255–296). New York, NY: Macmillan.

Clift, R. T., & Brady, P. (2005). Research on methods courses and field experiences. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA panel on research and teacher education,* (pp. 309–424). Mahwah, NJ: Erlbaum.

Cobb, P., & Bowers, J. S. (1999). Cognitive and situated learning perspectives in theory and practice. *Educational Researcher, 28*(2) 4–15.

Cochran-Smith, M. (1991). Learning to teach against the grain. *Harvard Educational Review, 61,* 279–310.

Cochran-Smith, M., Feiman-Nemser, S., & McIntyre, J. D. (Eds.). (2008). *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 697–705). New York, NY: Routledge.

Cochran-Smith, M., & Fries, M. K. (2001). Sticks, stones and ideology: The discourse of reform in teacher education. *Educational Researcher, 30*(8), 3–15.

Cochran-Smith, M., & Fries, M. K. (2005). Researching teacher education in changing times. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA panel on research and teacher education* (pp. 69–109). Mahwah, NJ: Erlbaum.

Cochran-Smith, M., & Lytle, S. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education, 24* (pp. 249–305). Washington, DC: American Educational Research Association.

Cochran-Smith, M., & Zeichner, K. (Eds.) (2005). *Studying teacher education: The report of the AERA panel on research and teacher education*. Mahwah, NJ: Erlbaum.

Cohen, D. K. (2011). *Teaching and its predicaments*. Cambridge, MA: Harvard University Press.

Cohen, D. K. (1989). Teaching practice: Plus ca change. In P. W. Jackson (Ed.), *Contributing to educational change: Perspectives on research and practice* (pp. 27–84). Berkeley, CA: McCutchan.

Cohen, D. K., McLaughlin, M. W., & Talbert, J. E. (Eds.). (1993). *Teaching for understanding: Challenges for policy and practice*. San Francisco, CA: Jossey-Bass.

Cossentino, J. (2009). Culture, craft, & coherence: The unexpected vitality of Montessori teacher training. *Journal of Teacher Education, 60*(5), 520–527.

Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L. (1997). *The right to learn: A blueprint for creating schools that work*. San Francisco, CA: Jossey-Bass.

Darling-Hammond, L., & Bransford, J. (Eds.). (2005). *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco, CA: Jossey-Bass.

Darling-Hammond, L., Wei, R. C., with Johnson, C. M. (2009). Teacher preparation and teacher learning: A changing policy landscape. In G. Sykes, B. L. Schneider, & D. N. Plank (Eds.), *Handbook of education policy research* (pp. 613–636). New York, NY: American Educational Research Association and Routledge.

Darling-Hammond, L., Wise, A., & Klein, S. P. (1999). *A license to teach: Raising standards for teaching*. San Francisco, CA: Jossey-Bass.

Delpit, L. (1995). *Other people's children: Cultural conflict in the classroom*. New York, NY: New Press.

Deshano da Silva, C., Huguley, J. P., Kakli, Z., & Rao, R. (2007). *The opportunity gap: Achievement and inequality in education*. Cambridge, MA: Harvard University Press.

Dewey, J. (1904). The relation of theory to practice in education. In C. A. McMurray (Ed.), *The relation of theory to practice in the education of teachers* (Third Yearbook of the National Society for the Scientific Study of Education, Part I). Bloomington, IL: Public School Publishing.

Duncan, A. (October, 2009). *Teacher preparation: Reforming the uncertain profession.* Address presented at Teachers College, Columbia University.

Elbaz, F. (1983). *Teacher thinking: A study of practical knowledge*. London, UK: Croom Helm.

Feiman-Nemser, S. (2008). Teacher learning: How do teachers learn to teach? In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 697–705). New York, NY: Routledge.

Feiman-Nemser, S. (2001a). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103* (6), 1013–1055.

Feiman-Nemser, S. (2001b). Helping novices learn to teach: Lessons from an exemplary support teacher. *Journal of Teacher Education, 52* (1), 17–30.

Feiman-Nemser, S., & Remillard, J. (1996). Perspectives on learning to teach. In F. B. Murray (Ed.), *The teacher educator's handbook* (pp. 63–91). San Francisco, CA: Jossey-Bass.

Fenstermacher, G., & Richardson, V. (1993). The elicitation and reconstruction of practical arguments in teaching. *Journal of Curriculum Studies, 25,* 101–114.

Finn, C. E. (2001). Getting better teachers. In T. Moe (Ed.), *A primer on America's schools*. Stanford, CA: Hoover Institution Press.

Floden, R., & Meniketti, M. (2005). Research on effects of coursework in the arts and sciences and in the foundations of education. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA panel on research and teacher education* (pp. 261–308). Mahwah, NJ: Erlbaum.

Fraser, J. (2007). *Preparing America's teachers: A history.* New York, NY: Teachers College Press.

Gallego, M. (2001). Is experience the best teacher? The potential of coupling classroom and community-based field experiences. *Journal of Teacher Education, 52,* 312–325.

Gess-Newsome, J. & Lederman, N. G. (1993). Preservice biology teachers' knowledge structures as a function of professional teacher education: A yearlong assessment. *Science Education, 77,* 22–45.

Goldenberg, C., & Gallimore, R. (1991). Changing teaching takes more than a one-shot workshop. *Educational Leadership, 49* (3), 69–72.

Greeno, J. G. (1997). On claims that answer the wrong questions. *Educational Researcher, 26* (1), 5–17.

Greeno, J. G., & the Middle School Through Applications Project Group. (1998). The situativity of knowing, learning, and research. *American Psychologist, 53,* 5–26.

Griffith, G., & Early, M. (Eds.). (1999). *The education of teachers: Ninety-eighth yearbook of the National Society for the Study of Education*. Chicago, IL: University of Chicago Press.

Grossman, P. L. (1990). *The making of a teacher*. New York, NY: Teachers College Press.

Grossman, P. L. (2005). Research on pedagogical approaches in teacher education. In M. Cochran-Smith & K. Zeichner (Eds.). *Studying teacher education: The report of the AERA panel on research and teacher education* (pp. 425–476). Mahwah, NJ: Erlbaum.

Grossman, P. L., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record, 111* (9), 2055–2100.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching: Theory and Practice, 15* (2), 273–289.

Grossman, P. L., Smagorinsky, P., & Valencia, S. (1999, November). Appropriating tools for teaching English: A theoretical framework for research on learning to teach. *American Journal of Education, 108,* 1–29.

Grossman, P. L., & Thompson, C. (2008). Learning from curriculum materials: Scaffolds for new teachers? *Teaching and teacher education, 24,* 2014–2026.

Grossman, P. L., Wilson, S. M., & Shulman, L. S. (1989). Teachers of substance: Subject matter knowledge for teaching. In M. Reynolds (Ed.), *Knowledge base for the beginning teacher* (pp. 23–36). New York, NY: Pergamon Press.

Gutierrez, K., & Vossoughi, S. (2010). Lifting off the ground to return anew: Mediated praxis, transformative learning, and social design experiments. *Journal of Teacher Education, 61* (1), 100–117.

Hartocollis, A. (2005, July 31). Teaching the teachers: Who needs education schools? *New York Times*.

Hatano, G., & Inagaki, K. (1986). Two courses of expertise. In H. Stevenson, H. Azuma, & K. Hakuta (Eds.), *Child development and education in Japan* (pp. 262–272). New York, NY: Freeman.

Hatano, G., & Oura, Y. (2003). Commentary: Reconceptualizing school learning using insight from expertise research. *Educational Researcher, 32* (8), 26–29.

Hess, F. H., Rotherham, A. J., & Walsh, K. (Eds.). (2004). *A qualified teacher in every classroom?: Appraising old answers and new ideas*. Cambridge, MA: Harvard Education.

Hollins, E. R., & Torres-Guzman, M. (2005). Research on preparing teachers for diverse populations. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA panel on research and teacher education* (pp. 477–544). Mahwah, NJ: Erlbaum.

Hollingsworth, S. (1989). Prior beliefs and cognitive change in learning to teach. *American Educational Research Journal, 26,* 160–189.

Houston, W. R. (Ed.). (1990). *Handbook of research on teacher education*. New York, NY: Macmillan.

Imig, D., & Imig, S. (2008). From traditional certification to competitive certification: A twenty-five year retrospective. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 886–907). New York, NY: Routledge.

Jackson, P. (1968). *Life in classrooms*. Austin, TX: Holt, Rinehart & Winston.

Johnson, S. M., & the Project on the Next Generation of Teachers. (2004). *Finders and keepers: Helping new teachers survive and thrive in our schools*. San Francisco, CA: Jossey-Bass.

Kagan, D. M. (1992). Professional growth among preservice and beginning teachers. *Review of Educational Research, 62* (2), 129–169.

Kansanen, P., Tirri, K., Meri, M., Krokfors, L., Husu, J., & Jyrhama, R. (2000). *Teachers' pedagogical thinking: Theoretical landscapes, practical challenges*. New York, NY: Peter Lang.

Katz, D., & Feiman-Nemser, S. (2004). New teacher induction in a culture of professional development. In J. I. Goodlad & J. McMannon (Eds.), *The teaching career* (pp. 96–116). New York, NY: Teachers College Press.

Kennedy, M. (1996). Research genres in teacher education. In F. B. Murray (Ed.), *The teacher educator's handbook: Building a knowledge base for the preparation of teachers* (pp. 120–152). San Francisco, CA: Jossey-Bass.

Kennedy, M. (1998). *Learning to teach writing: Does teacher education make a difference?* New York, NY: Teachers College Press.

Kennedy, M. (1999a). The problem of evidence in teacher education. In R. A. Roth (Ed.), *The role of the university in the preparation of teachers* (pp. 87–107). Philadelphia, PA: Falmer Press.

Kennedy, M. (1999b). The role of preservice education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 54–85). San Francisco, CA: Jossey-Bass.

Khortagen, F. (2010). Situative learning theory and the pedagogy of teacher education: Towards an integrative view of teacher behavior and teacher learning. *Teaching and teacher education, 26,* 98–106.

Khortagen, F., Kessels, J. P., Koster, B., Wubbels, T., & Lagerwerf, B. (2001). *Linking practice and theory: The pedagogy of realistic teacher education*. Mahwah, NJ: Erlbaum.

King, J. E., Hollins, E. R., & Hayman, W. C. (1997). *Preparing teachers for cultural diversity*. New York, NY: Teachers College.

Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in U.S. schools. *Educational Researcher, 35*(7), 3–12.

Ladson-Billings, G. (1999). Preparing teachers for diversity: Historical perspectives, current trends, and future directions. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 86–123). San Francisco, CA: Jossey-Bass.

Lampert, M. (2001). Teaching problems and the problems of teaching. New Haven, CT: Yale University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University.

Lemov, D. (2010). *Teach like a champion*. San Francisco, CA: Jossey Bass.

Levin, J. R., & O'Donnell, A. M. (1999). What to do about educational researcher's credibility gaps? *Issues in Education, 5*, 177–229.

Levine, A. (2006). *Educating school teachers*. Washington, DC: Education Schools Project.

Lortie, D. (1975). *Schoolteacher: A sociological study*. Chicago, IL: University of Chicago Press.

Louden, W. (1991). *Understanding teaching: Continuity and change in teachers' knowledge*. New York, NY: Teachers College.

Lucas, C. J. (1997). *Teacher education in America: Reform agendas for the 21st century*. New York, NY: St. Martins.

Lucas, T., & Grinberg, J. (2008). Preparing all teachers to teach ELLs. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 606–636). New York, NY: Routledge.

McDiarmid, G. W. (1990). Challenging prospective teachers' beliefs during early field experience: A quixotic undertaking? *Journal of Teacher Education, 41*(3), 12–20.

McDonald, J. (1992). *Teaching as an uncertain craft*. New York, NY: Teachers College.

McWilliam, E. (1994). *In broken images: Feminist tales for a different teacher education*. New York, NY: Teachers College Press.

Murray, F. B. (Ed.), (1996a). *The teacher educator's handbook: Building a knowledge base for the preparation of teachers*. San Francisco, CA: Jossey-Bass.

Murray, F. B. (1996b). Beyond natural teaching: The case for professional education. In F. B. Murray (Ed.), *The teacher educator's handbook: Building a knowledge base for the preparation of teachers* (pp. 3–13). San Francisco, CA: Jossey-Bass.

National Commission on Teaching and America's Future. (1996). *What matters most: Teaching for America's future*. New York, NY: Author.

National Research Council. (2010). *Preparing teachers: Building evidence for sound policy*. Washington, DC: National Academies Press.

Nuthall, G. (1997). Understanding student thinking and learning in the classroom. In B. J. Biddle, T. L. Good, & I. F. Goodson (Eds.), *International handbook of teachers and teaching* (Vol. II, pp. 681–768). Dordrecht, The Netherlands: Kluwer.

Otterman, S. (2011, July 21). Ed schools' pedagogical puzzle. *New York Times.*

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307–322.

Pressley, M., & Roehrig, A. (2002). Educational psychology in the modern era: 1960 to the present. In D. Zimmerman & D. Schunk (Eds.), *Educational psychology: A century of contributions*. Mahwah, NJ: Erlbaum.

Pressley, M., Roehrig, A., Raphael, L., Dolezal, S., Bohn, K., Mohan, L., . . . Hogan, K. (2002). Teaching processes. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* (pp. 153–175). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology*. Hoboken, NJ: Wiley.

Putnam, R., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good, & I. F. Goodson (Eds.), *International handbook of teachers and teaching* (Vol. II, pp. 1223–1296). Dordrecht, The Netherlands: Kluwer.

Putnam, R., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29*(1), 4–15.

Resnick, L. (1991). Shared cognition: Thinking as social practice. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 1–20). Washington, DC: American Psychological Association.

Reynolds, A. (1992). What is competent beginning teaching? A review of the literature. *Review of Educational Research, 62*(1), 1–35.

Reynolds, M. C. (Ed.). (1989). *Knowledge base for the beginning teacher*. New York, NY: Pergamon.

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula, T. Buttery, & E. Gutor (Eds.), *Handbook of research on teacher education* (2nd ed., pp. 102–199). New York, NY: Macmillan.

Richardson, V. (Ed.). (1997). *Constructivist teacher education: Building new understandings*. Washington, DC: Falmer.

Richardson, V. (2001). *Handbook of research on teaching* (4th ed.). Washington, DC: American Educational Research Association.

Richardson-Koehler, V. (Ed.). (1987). *Educators' handbook: A research perspective*. New York, NY: Longman.

Richardson, V., & Placier, P. (2001). Teacher change. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 905–947). Washington, DC: American Educational Research Association.

Rosaen, C., & Florio-Ruane, S. (2008). The metaphors by which we teach: Experience, metaphor, and culture in teacher education. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 706–731). New York, NY: Routledge.

Ross, E. W., Cornett, J. W., & McCutcheon, G. (1992). *Teacher personal theorizing: Connecting curriculum practice, theory, and research*. Albany, NY: State University of New York Press.

Rumelhart, D. E., & Norman, D. (1976). *Accretion, tuning, restructuring: Three models of learning* (Report No. 7062). La Jolla, CA: La Jolla Center for Human Information Processing.

Sapon-Shevin, M., & Chandler-Olcott, K. (2001). Student cohorts: Communities of critique or dysfunctional families? *Journal of Teacher Education, 52*, 350–364.

Schwab, J. (1964). The structure of disciplines: Meanings and significance. In G. W. Ford & L. Pugno (Eds.), *The structure of knowledge and the curriculum*. Chicago, IL: Rand McNally.

Shavelson, R. J., & Towne, L. (Eds.). (2002). *Scientific research in education*. Washington, DC: National Research Council, National Academy Press.

Sherin, M. G. (2000). Viewing teaching on videotape. *Educational Leadership, 57*(8), 36–38.

Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (Eds.) (2011). *Mathematics teacher noticing: Seeing through teacher's eyes*. New York, NY: Routledge.

Shulman, L. S. (1986a). Paradigms and research programs in the study of teaching: A contemporary perspective. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 3–36). New York, NY: Macmillan.

Shulman, L. S. (1986b). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1–22.

Sikula, J., Buttery, T., & Guyton, E. (Eds.). (1996). *Handbook of research on teacher education,* (2nd ed.). New York, NY: Macmillan.

Sirotnik, K. A., & Goodlad, J. I. (Eds.). (1988). *School-university partnerships in action: Concepts, cases, and concerns*. New York, NY: Teachers College Press.

Sleeter, C. E. (2008). Preparing white teachers for diverse students. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 557–582). New York, NY: Routledge.

Tabachnich, B. R., & Zeichner, K. (1991). *Issues and practices of inquiry-oriented teacher education*. London/New York: Falmer.

Tharp, R., & Gallimore, R. (1988). *Rousing minds to life*. Cambridge, UK: Cambridge University Press.

Towne, L, Wise, L., & Winters, T. (Eds.) (2004). *Advancing scientific research in education*. Washington, DC: National Research Council, National Academy Press.

Villegas, A. M. (2007). Dispositions in teacher education. *Journal of Teacher Education, 58*(5), 370–380.

Weinstein, C. S. (1989). Teacher education students' preconceptions of teaching. *Journal of Teacher Education, 5,* 161–182.

Weinstein, C. S. (1990). Prospective elementary teachers' beliefs about teaching: Implications for teacher education. *Teaching and Teacher Education, 6,* 279–290.

Whitcomb, J. (2010). Conceptions of teacher education. In P. Peterson, E. Baker, & B. McGaw (Eds.), *The International encyclopedia of education,* (Vol. 7, pp. 598–603). Oxford, UK: Elsevier.

Wideen, M., Mayer-Smith, J., & Moon, B. (1998). A critical analysis of the research on learning to teach: Making the case for an ecological perspective on inquiry. *Review of Educational Research, 68,* 130–178.

Wilcox, S., Schram, P., Lappan, G., & Lanier, P. (1991). *The role of a learning community in changing preservice teachers' knowledge* (Research Report 91–1). East Lansing: National Center for Research on Teacher Learning, College of Education, Michigan State University.

Will, G. (2006, January 16). Ed schools versus education. *Newsweek*.

Wilson, S. M., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. In A. Iran-Nehad & P. D. Pearson (Eds.), *Review of research in education* (pp. 173–209), 24. Washington, DC: American Educational Research Association.

Wilson, S. M., Floden, R. E., & Ferrini-Mundy, J. (2001). *Teacher preparation research: Current knowledge, gaps, and recommendations*. Seattle: Center for Study of Teaching and Policy. University of Washington. Document R-01-03.

Wilson, S. M., Shulman, L. S., & Richert, A. E. (1987). 150 different ways of knowing: Representations of knowledge in teaching. In J. Calderhead (Ed.), *Exploring teachers thinking* (pp. 104–24). London, UK: Cassell.

Wilson, S. M., & Tamir, E. (2008). The evolving field of teacher education: How understanding challenge(r)s might improve the preparation of teachers. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 908–935). New York, NY: Routledge.

Wilson, S. M., & Wineburg, S. (1988). Peering at American history through different lenses: The role of disciplinary knowledge in teaching. *Teachers College Record, 89,* 525–39.

Wineburg, S. & Grossman, P. (1998). Creating a community of learnings among high school teachers. *Phi Delta Kappan, 73,* 684–689.

Windshitl, M., Thompson, J., & Braaten, M. (2011). Ambitious pedagogy by novice teachers: Who benefits from tool-supported collaborative inquiry into practice and why? *Teachers College Record, 113*(7). www.tcrecord.org

Windshitl, M., Thompson, J., Braaten, M., Stroupe, D., Chew, C., & Wright, E. (in press). The beginner's repertoire: proposing a core set of instructional practices for teacher preparation. In I. Saleh & M. Khine (Eds.), *Teaching teachers: Approaches in improving quality of education*. Hauppauge, NY: Nova.

Zeichner, K. (1999). The new scholarship in teacher education. *Educational Researcher, 28*(9), 4–15.

Zeichner, K. (2010). Rethinking the connections between campus courses and field experiences in college- and university-based teacher education. *Journal of Teacher Education, 61*(1–2), 89–99.

Zeichner, K., & Gore, J. (1990). Teacher socialization. In W. R. Houston, M. Haberman, & J. Sikula (Eds.), *Handbook of research on teacher education* (pp. 329–348). New York, NY: Macmillan.

Zeichner, K., Melnick, S., & Gomez, M. L. (1996). *Currents of reform in preservice teacher education.* New York, NY: Teachers College.

Zeichner, K., Tabachnich, B. R., & Densmore, K. (1987). Individual institutional, and cultural influences on the development of teachers' craft knowledge. In J. Calderhead (Ed.), *Exploring teachers' thinking* (pp. 21–59). London, UK: Cassell.

CHAPTER 19

Educational/Psychological Intervention Research Circa 2012

JOEL R. LEVIN AND THOMAS R. KRATOCHWILL

EDUCATIONAL/PSYCHOLOGICAL INTERVENTION RESEARCH CIRCA 2012

> The problems that are faced in experimental design in the social sciences are quite unlike those of the physical sciences. Problems of experimental design have had to be solved in the actual conduct of social-sciences research; now their solutions have to be formalized more efficiently and taught more efficiently. Looking through issues of the *Review of Educational Research,* one is struck time and again by the complete failure of the authors to recognize the simplest points about scientific evidence in a statistical field. The fact that 85 percent of National Merit Scholars are first-born is quoted as if it means something, without figures for the over-all population proportion in small families and over-all population proportion that is first-born . . . One cannot apply anything one learns from descriptive research to the construction of theories or to the improvement of education without having some causal data with which to implement it. (Scriven, 1960, p. 426)

> Education research does not provide critical, trustworthy, policy-relevant information about problems of compelling interest to the education public. A recent report of the U.S. Government Accounting Office (GAO, 1997) offers a damning indictment of evaluation research. The report notes that over a 30-year period the nation has invested $31 billion in Head Start and has served over 15 million children. However, the very limited research base available does not permit one to offer compelling evidence that Head Start makes a lasting difference or to discount the view that it has conclusively established its value. There simply are too few high-quality studies available to provide sound policy direction for a hugely important national program. The GAO found only 22 studies out of hundreds conducted that met its standards, noting that many of those rejected failed the basic methodological requirement of establishing compatible comparison groups. No study using a nationally representative sample was found to exist. (Sroufe, 1997, p. 27)

The opening two excerpts provide a sobering account of exactly how far the perceived quality of educational research has advanced in two generations. Now, nearly an additional decade has passed since we reviewed, in the 2003 volume of this *Handbook* series, the character and quality of intervention research in education and in certain areas of psychology. Here we update our 2003 chapter and report on the state of educational/psychological intervention research as we enter the second decade of the 21st century. In what follows, we argue for the application of rigorous research methodologies and the criticality

---

In 1999 Joel Levin and Angela O'Donnell published an article, "What to do about educational research's credibility gaps?" in *Issues in Education: Contributions from Educational Psychology*, a professional journal with limited circulation. With the kind permission of *Issues'* then-editor Jerry Carlson and publisher George Johnson, major portions of the "What to do . . . ?" article have been appropriated to constitute the bulk of the present chapter. We are grateful to Angela O'Donnell for her contributions to our chapter in the first edition of the Handbook, many of which have been incorporated into this updated chapter.

of supporting evidence. As will be developed throughout this chapter, the notion of "evidence—specifically, what we are increasingly seeing as vanishing evidence of evidence—is central to our considerable dismay concerning the past, present, and future plight of educational research, in general, and of research incorporating educational/psychological treatments or interventions, in particular (see, for example, Hsieh et al., 2005; Whitehurst, 2003). We maintain that "improving the 'awful reputation' of education research" (Kaestle, 1993; Sroufe, 1997) begins with efforts to enhance the credibility of the research's evidence.

Improving the quality of intervention research in education and psychology has been a primary goal of scholars and researchers throughout the history of these scientific disciplines. Broadly conceived, intervention research is designed to produce "credible" (trustworthy, dependable—see Levin, 1994) knowledge that can be translated into practices that affect (optimistically, practices that *improve*) the mental health and education of all individuals. Yet, beyond this general goal there has always been disagreement about the objectives of intervention research and the methodological and analytic tools that can be counted on to produce credible knowledge. One purpose of this chapter is to review some of the controversies that have befallen psychological and educational intervention research. A second, and the major, purpose of this chapter is to suggest attainable possibilities for enhancing the credibility of intervention research. At the least, we hope that our musings will lead the reader to consider certain fundamental assumptions of what much educational and psychological intervention research currently is and what it can be.

CONTEMPORARY METHODOLOGICAL ISSUES: AN OVERVIEW

In the social sciences, research inquiry—in terms of methodologies and data analyses/interpretation—takes many and varied forms, with each form serving a different purpose (for an extensive sampling within the field of education, see Green, Camilli, & Elmore, 2006; Raudenbush, 2005; Shavelson & Towne, 2002). Educational intervention research seeks to address the question of whether the introduction of a new or different set of conditions can bring about desired educational outcomes. Examples include introducing: an instructional method (e.g., an alternative content-area or learning-strategy approach presented in a textbook, by a teacher, or via computer to increase student achievement); a treatment (e.g., a behavioral intervention to reduce the classroom disruptive behavior of a targeted student or a group of students); a policy (e.g., classroom-, school-, or district-wide reductions in class size or the implementation of same-gender classrooms, mandatory homework, charter schools, or after-school programs to attain selected educational goals).

Although there is general consensus among researchers that intervention research is critical to the advancement of knowledge for practice, there is fundamental disagreement about the methodologies used to study questions of interest. These include such issues as the nature of participant selection, differential concerns for internal validity and external validity (Campbell & Stanley, 1966; Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002), the desirability or possibility of intervention-effect generalization, appropriate data-analytic techniques, among others that are discussed later in this chapter.

Evidence-Based Interventions and Practices

Of the major movements in psychology and education, few have stirred as much excitement or controversy as have efforts to produce evidence-based interventions. With its origins in medicine and clinical-trials research, the evidence-based practice (EBP) movement spread to clinical psychology (see Chambless & Ollendick, 2001, for a historical overview; Hitt, 2001), educational psychology, and school psychology (Kratochwill & Shernoff, 2003). The movement has spawned two major task forces of the American Psychological Association (APA), with reports initially focused primarily on adults (American Psychological Association Presidential Task Force on Evidence-based Practice, 2006) and later, more specifically on children and adolescents (American Psychological Association Task Force on Evidence-Based Practice for Children and Adolescents, 2008). At the forefront of this movement has been so-called quantitative/experimental/scientific methodology as the primary tool for establishing the knowledge base for treatment techniques and procedures, a methodology that has been endorsed by the APA Division 12 (Clinical Psychology) Task Force on Evidence-Based Treatments (Weisz & Hawley, 2001). According to the Clinical Psychology Task Force, the criteria for deciding whether a treatment is evidence based is determined by quantitative group-based and single-participant studies.

The School Psychology Task Force, sponsored by APA Division 16, the Society for the Study of School

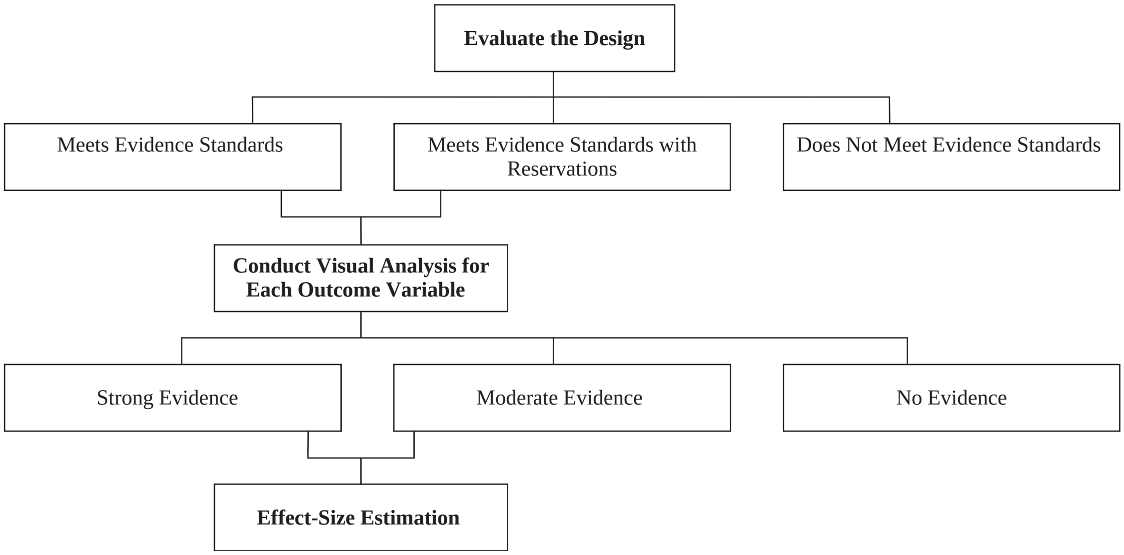


Figure 19.1 Figural representation of single-case intervention design and analysis standards (Kratochwill et al., 2010)

Psychology, and the National Association of School Psychologists also developed criteria for reviewing interventions (see Kratochwill & Stoiber, 2002). In contrast to their clinical psychology colleagues' considerations, those of the School Psychology Task Force differ in at least two fundamental ways. First, the quantitative criteria involve a "dimensional" rating of various designs, namely those representing internal validity, statistical conclusion validity, external validity, and construct validity. Thus, the evidence associated with each dimension is based on a Likert-scale rating and places responsibility on the consumer for weighing and taking into account the available support for the various interventions under consideration.

A second feature that distinguishes the School Psychology Task Force considerations from previous evidence-based efforts is the former's focus on a broad range of methodological strategies to establish evidence for an intervention. In this regard, the School Psychology Task Force developed criteria for coding "qualitative" methods in intervention research. At the same time, a premium has been placed on "quantitative" methodologies as the primary basis for establishing credible evidence for interventions (see Kratochwill & Stoiber, 2000, 2002).[1]

The What Works Clearinghouse (WWC) has also developed standards for a variety of quantitative research approaches that can be used to inform the database for EBPs in education. The WWC first developed standards for randomized controlled trials and quasi-experiments (What Works Clearinghouse, 2008; see also Boruch, 2007). However, in 2008, a Single-Case Design (SCD) methodology panel was formed to draft standards for such methods (Kratochwill et al., in press); and around the same time the WWC produced standards for regression discontinuity designs (Schochet et al., 2010).

One unique feature of the SCD Standards is that the panel developed a framework that incorporates both design and evidence standards (see Figure 19.1). In the case of design standards (the upper portion of Figure 19.1), the three most commonly implemented SCDs are featured, including ABAB [two baseline (A) and two intervention (B) phases], multiple-baseline, and alternating treatment designs (for further information on these designs and their variations, see Barlow, Nock, & Hersen, 2009; Gast, 2010; Horner et al., 2005; Kazdin, 2011). Single-case intervention studies must meet design standards in conjunction with replication criteria that are defined separately for each of the major design classes. In the case of evidence standards (the lower portion of Figure 19.1), a study's outcomes are evaluated on the basis of the data-analysis method that is most commonly applied in single-case intervention studies (visual/graphical analysis), with such features as mean change, trend, variability, and score overlap taken into account (Horner & Spaulding, 2010). It is important to note that the SCD Standards admit "negative results" (i.e., failures to produce intended effects) into the evidence database of various interventions (see Barlow,

[1]As has been previously pointed out, the terms "qualitative" and "quantitative" are oversimplified, inadequate descriptors of the methodological and data-analytic strategies associated with them (Levin & Robinson, 1999) and so here we will refer to the respective movements with quotation marks.

2010, for the importance of attending to negative results in psychotherapy research). All of the professional groups identified above generally placed an emphasis on "quantitative" (rather than "qualitative") methods to produce the evidence base for their particular practice. At the same time, the higher status placed on "quantitative" methods is not shared among all scholars of intervention research methodology and sets the stage for some of the ongoing debate that is described in the following section.

"Quantitative" Versus "Qualitative" Research Approaches

For almost the past 20 years, much has been written about differing research methodologies, the contribution of educational research to society, and the "proper" functions and purposes of scientific research (e.g., Doyle & Carter, 1996; Kaestle, 1993; Labaree, 1998; O'Donnell & Levin, 2001). Some of these disputes have crystallized into an extended debate about "quantitative" and "qualitative" methodologies and their associated warrants for research outcomes—a debate, we might add, that has thrived not just within education but within other social-sciences academic domains as well (e.g., Azar, 1999; Lipsey & Cordray, 2000).

What accounts for the growing interest in qualitative methodologies? Partly as a function of the concern for authentic environments and contextual cognition (see Levin & O'Donnell, 1999, pp. 184–187; O'Donnell & Levin, 2001, pp. 79–80), there has been a press for alternatives to traditional experimental methodologies in educational research. Concerns for external validity, consideration of the complexity of human behavior, and the emergence of sociocultural theory as part of the theoretical fabric for understanding educational processes have also resulted in the widespread adoption of more "qualitative" methods. In terms of Krathwohl's (1993) distinctions among description, explanation, and validation (summarized by Jaeger & Bond, 1996, p. 877), the primary goals of educational research, for example, have been to observe and describe complex phenomena (e.g., classroom interactions and behaviors) rather than to manipulate treatments and conduct confirming statistical analyses of the associated outcomes.

The reasons for disagreements between "quantitative" and "qualitative" researchers are much more than a debate about the respective methodologies. They are deeply rooted in beliefs about the appropriate *function* of scientific research. Criticism of "quantitative" methodologies has often gone hand in hand with a dismissal of empiricism. Rejection of "qualitative" methodologies has often centered on imprecision of measurement, problems with generalizability, and the quality and credibility of evidence. Failures to resolve—or even to address—the "appropriate research function" issue have resulted in a limiting focus in the debate between "qualitative" and "quantitative" orientations that trivialize important methodological distinctions and purposes. Unfortunately, the debate has often been ill conceived and unfairly portrayed, with participants not recognizing advances that have been made in both "qualitative" and "quantitative" methodology within the past 20 years (see, for example, Green et al., 2006). The availability of alternative methodologies and data-analytic techniques highlights a key issue among researchers regarding the rationale for their work and the associated direction of their research efforts. Wittrock (1994) points out the need for a richer variety of naturalistic "qualitative" and "quantitative" methodologies, ranging from case studies and observations to multivariate designs and analyses.

In addition, arguments about appropriate methodology have often been confused with a different argument about the nature of scholarship. Beginning with Ernest Boyer's (1990) book, *Scholarship Reconsidered: Priorities of the Professoriate,* institutions of higher education have sought ways to broaden the concept of scholarship to include work that does not involve generating new knowledge. This debate is often confused with the methodological debate between the respective advocates of Aqualitative≅ and Aquantitative ≅ approaches, but an important feature of this latter debate is that it focuses on *methods* of knowledge generation (see also Jaeger, 1988; and Green et al., 2006).

RESEARCH METHODOLOGY AND THE CONCEPT OF CREDIBLE EVIDENCE

Our purpose here is not to prescribe the tasks, behaviors, or problems that researchers *should* be researching (i.e., the *topics* of psychological and educational intervention research). Some of these issues have been addressed by various review groups (e.g., Shavelson & Towne, 2002), as well as by task forces in school and clinical psychology. As Calfee (1992) noted in his reflections on the field of educational psychology, researchers are generally doing quite well in their investigation of issues of both psychological and educational importance. As such, what is needed in the future can be characterized more as "refining" rather than as "redefining" the nature of that research.

For Calfee, "refining" means relating all research efforts and findings in some way to the process of schooling by "filling gaps in our present endeavors" (p. 165). For the present authors, in contrast, "refining" means enhancing the *scientific integrity* and *evidence credibility* of intervention research, irrespective of whether that research is conducted inside or outside of schools.

Credible Versus Creditable Intervention Research

We start with the assertion, made by Levin (1994) in regard to educational-intervention research, that a false dichotomy is typically created to distinguish between "basic" (laboratory-based) and "applied" (school-based) research: (1) What is the dichotomy? and (2) Why is it false? The answer to Question 1 addresses the methodological rigor of the research conducted, and that can be related to the concept of internal validity, as reflected in the following prototypical pronouncement: "Applied research (e.g., school-based research) and other real-world investigations are inherently complex and therefore must be methodologically weaker, whereas laboratory research can be more tightly controlled and, therefore, is methodologically stronger."

In many researchers' minds, laboratory-based research connotes "well controlled" whereas school-based research connotes "less well controlled" (e.g., Levin, 1994; Mosteller & Boruch, 2002; also see Eisner, 1999, for an example of this perspective). The same sort of prototypical packaging of laboratory versus classroom research was evident in the National Science Foundation's (NSF) 1999 draft guidelines for evaluating research proposals on Mathematics and Science Education (Suter, 1999). As is argued in a later section of this chapter, none of these stated "limitations" is critical, or even material, as far as conducting scientifically sound applied research (e.g., classroom-based research) is concerned.

The answer to Question 2 is that just because different research modes (school-based versus laboratory-based) have *traditionally* been associated with different methodological-quality adjectives (weaker versus stronger, respectively), that is not an inevitable consequence of the differing research venues (see also Levin, 1994; Stanovich, 2007, Chapter 12). Laboratory-based research can be methodologically weak and school-based research methodologically strong. As such, the methodological rigor of a piece of research dictates directly the "credibility" (Levin, 1994; Murnane & Willett, 2011) of its evidence, or the "trustworthiness" (Jaeger & Bond, 1996) of the research findings and associated conclusions (see also Kratochwill & Stoiber, 2000). Research credibility should not be confused with the educational/societal importance of the questions being addressed, which has been referred to as the research's "creditability" (Levin, 1994). In our view (and consistent with Campbell & Stanley's, 1966 *sine qua non* dictum), scientific credibility should be first and foremost in the educational research equation, particularly when it comes to evaluating the potential of classroom, school, and community interventions (see also Jaeger & Bond, 1996, pp. 878–883; Slavin, 2002).

With the addition of both substantive creditability and external validity standards (to be specified later) to scientifically credible investigations, one has what we believe to be the ideal manifestation of intervention research.[2] That ideal surely captures Cole's (1997, p. 17) vision for the future of "both useful research and research based on evidence and generalizability of results." For example, two empirical investigations addressing the creditable instructional objective of teaching/improving students' writing from fundamentally different credible methodological approaches, one within a carefully controlled laboratory context (Townsend et al., 1993) and the other systematically within the context of actual writing-instructed classrooms (Needels & Knapp, 1994), serve to punctuate the present points. Several examples of large-scale scientifically credible research studies with the potential to yield creditable prescriptions are provided later in this chapter, in the context of a framework for conceptualizing different stages of educational intervention research.

Components of CAREful Intervention Research

In our view, credible evidence follows from the conduct of credible research, which in turn follows directly from Campbell and Stanley's (1966) methodological precepts (for a contrasting view, see McCombs, this volume). The essence of both scientific research and credible research methodology can in turn be reduced to the four components of what Levin (1997b) and Derry, Levin, Osana, Jones, and Peterson (2000) have referred to as "CAREful" intervention research: ***C***omparison, ***A***gain and again, ***R***elationship, and ***E***liminate. In particular, it can be argued

[2]Levin (2004) subsequently added the alliteratively similar term "accretability" to the set of critical educational intervention-research components, where the term encompasses the external validity notions of results replicability and their generalizability to other participant populations and situational contexts (e.g., Bracht & Glass, 1968).

that evidence linking an intervention to a specified outcome is scientifically convincing if: (1) the evidence is based on a ***C***omparison that is appropriate (e.g., comparing the intervention to an appropriate alternative or nonintervention condition); (2) the outcome is produced by the intervention ***A***gain and again (i.e., it has been "replicated," initially across participants or observations in a single study and ultimately through independently conducted studies); (3) there is a direct ***R***elationship (i.e., a connection) between the intervention and the outcome; and (4) all other reasonable competing explanations for the outcome can be ***E***liminated [typically, through random assignment of participants to intervention conditions (*randomization*) and methodological precision]. Succinctly stated: If an appropriate ***C***omparison reveals ***A***gain and again evidence of a direct *R*elationship between an intervention and a specified outcome, while ***E***liminating all other competing explanations for the outcome, then the research yields scientifically convincing evidence of the intervention's effectiveness.

As might be inferred from the foregoing discussion, scientifically grounded *experiments* (including both group-based and single-case) represent the most commonly accepted vehicle for implementing all four CAREful research components. At the same time, other modes of empirical inquiry, including *quasi-experiments* and *observational/correlational studies,* as well as *surveys,* can be shown to incorporate one or more of the CAREful research components. In fact, being attuned to these four components when interpreting one's data is what separates careful researchers from not-so-careful ones, irrespective of their preferred general methodological orientations.

"Good" Evidence Is Hard to Find

If inner-city second graders take piano lessons and receive exercises that engage their spatial ability, will their mathematics skills improve? Yes, according to a newspaper account of a tantalizing research study (*Deseret News,* 1999). But maybe no, according to informed consumers of reports of this kind, because one's confidence in such a conclusion critically depends on the quality of the research conducted and the evidence obtained from it (see, for example, Marley & Levin, 2011; Murnane & Willett, 2011). Thus, how can we be confident that whatever math-skill improvements were observed resulted from students practicing the piano and computer-based spatial exercises, rather than from something else? Indeed, the implied causal explanation is that such practice served to foster the development of certain cognitive and neurological structures in the students, which in turn improved their mathematics skills: "When children learn rhythm, they are learning ratios, fractions and proportions . . . . With the keyboard, students have a clear visual representation of auditory space." Causal interpretations are more than "implicit" in earlier research on this topic, as reflected by the authors' outcome interpretations and even their article titles—for example, *Music training causes long-term enhancement of preschool children's spatial-temporal reasoning* (Rauscher et al., 1997).

In the same newspaper account, however, other researchers offered alternative explanations for the purported improvement of musically/spatially trained students, including the enhanced self-esteem the students may have experienced from such training and the positive "expectancy" effects communicated from teachers to students. Thus, at least in the newspaper account of the study, the evidence offered to support the preferred cause-and-effect argument is not compelling. Moreover, a review of the primary report of the research (Graziano, Peterson, & Shaw, 1999) reveals that in addition to the potential complications just mentioned, a number of methodological and statistical concerns seriously compromise the credibility of the study and its conclusions, including nonrandom assignment of either students or classrooms to the different intervention conditions, student attrition throughout the study's four-month duration, and an inappropriate implementation and analysis of the classroom-based intervention (to be discussed in a later section). The possibility that music instruction combined with training in spatial reasoning improves students' mathematics skill is an intriguing one and one to which we personally resonate. Until better-controlled research is conducted and more credible evidence is presented, however, the "possibility" must remain just that—see also Winner and Hetland's (1999) critical comments on this research, empirical studies by Steele, Bass, and Crook (1999) and Nantais and Schellenberg (1999), and Jenkins' (2001) conclusions about the so-called "Mozart effect" based on his review of the research literature.

In both our graduate and undergraduate educational psychology courses, we draw heavily from research, argument, and critical thinking concepts presented in three wonderfully wise and well-crafted books, *How to Think Straight about Psychology* (Stanovich, 2007), *Statistics as Principled Argument* (Abelson, 1995), and *Thought & Knowledge: An Introduction to Critical Thinking* (Halpern, 2003). Anyone who has not read these beauties should. And anyone who has read them and applied the principles therein to their own research should more than appreciate the role played by old-fashioned “evidence” in offering and supporting an argument, whether that argument is in a research or an everyday thinking context. In a research context, a major theme of all three books—as well as of the Clinical Psychology and School Psychology Task Forces and the WWC research standards—is the essentiality of providing solid (our “credible”) evidence to support conclusions about causal connections between independent and dependent variables. In terms of our present intervention research context and terminology, before one can attribute an educational outcome to an educational intervention, credible evidence must be provided that rules *in* the intervention as the proximate cause of the observed outcome, while at the same time ruling *out* alternative accounts for the observed outcome.

If all of this “stuff” sounds too stiff and formal (i.e., too academic), and maybe even too “outmoded” a view of research (Donmoyer, 1993; Mayer, 1993), let us restate it in terms of the down-to-earth advice offered to graduating seniors in a 1998 university commencement address given by Elizabeth Loftus, an expert on eye-witness testimony and then-president of the then American Psychological Society:[3]

> There’s a wonderful cartoon that appeared recently in Parade Magazine .... Picture this: mother and little son are sitting at the kitchen table. Apparently mom has just chided son for his excessive curiosity. The boy rises up and barks back, “Curiosity killed what cat? What was it curious about? What color was it? Did it have a name? How old was it?” I particularly like that last question ... maybe the cat was very old, and died of old age, and curiosity had nothing to do with it at all ... [M]y pick for the one advice morsel is simple: remember to ask the questions that good psychological scientists have learned to ask: “What’s the evidence?” and then, “What EXACTLY is the evidence?” (Loftus, 1998, p. 27)

Loftus (1998, p. 3) adds that one of the most important gifts of critical thinking is “knowing how to ask the right questions about any claim that someone might try to foist upon you.” In that regard, scientific research “is based on a fundamental insight—that the degree to which an idea seems true has nothing to do with whether it is true, and the way to distinguish factual ideas from false ones is to test them by experiment” (Loftus, 1998, p. 3). Similarly, in a popular press interview (Uchitelle, 1999), economist Alan Krueger argues for continually challenging conventional wisdom and theory with data: “The strength of a researcher is not in being an advocate, but in making scientific judgments based on the evidence. And empirical research teaches us that nothing is known with certainty” Stanovich (2007), in advancing his fanciful proposition that two “little green men” residing in the brain control all human functioning, analogizes in relation to other fascinating, though scientifically unsupported, phenomena such as extrasensory perception, that the “little green men” phenomenon:

> [I]s there as long as you don’t intrude to look at it carefully [scientifically]. When you do, it disappears. If we accept this explanation, it will be impossible to demonstrate the phenomenon to any skeptical observers. It appears only to believers. Of course, this position is unacceptable in science. We do not have the magnetism physicists and the nonmagnetism physicists (those for whom magnetism does and does not “work”). (Stanovich, 2007, pp. 254–255)

That intervention researchers are also prone to prolonged states of “evidencelessness” has been acknowledged for some time, as indicated in the following 50-year-old observation:

> A great revolution in social science has been taking place, particularly throughout the last decade or two. Many educational researchers are inadequately trained either to recognize it or to implement it. It is the revolution in the concept of evidence. (Scriven, 1960, p. 426)

We contend that the revolution referred to by Scriven has not produced a corresponding revelation in the field of intervention research. Consider, for example, the thoughts of mathematics educator, Thomas Romberg (1992), on the matter:

> The importance of having quality evidence cannot be overemphasized .... The primary role of researchers is to provide reliability evidence to back up claims. Too many people are inclined to accept any evidence or statements that are first presented to them urgently, clearly, and repeatedly .... A researcher tries to be one whose claims of knowing go beyond a mere opinion, guess, or flight of fancy, to responsible claims with sufficient grounds for affirmation .... Unfortunately, as any journal editor can testify, there are too many research studies in education in which either the validity or the reliability of the evidence is questionable. (Romberg, 1992, pp. 58–59)

In the pages that follow, we hope to provide evidence to support Scriven’s (1960) and Romberg’s (1992) assertions about the noticeable lacks of evidence in

---

[3]As is noted later in this chapter, the American Psychological Society has since been renamed the Association for Psychological Science.

contemporary educational and psychological intervention research.

The "Evidence" of Educational Intervention Research

The ESP model. Lamentably, in much educational intervention research today, rather than subscribing to the scientific method's principles of theory, hypothesis/prediction, systematic manipulation, observation, analysis, and interpretation, more and more investigators are subscribing to what might be dubbed the ESP principles of *E*xamine, *S*elect, and *P*rescribe. For example, a researcher may decide to *examine* a reading intervention. The researcher may not have well-defined notions about the specific external (instructional) and internal (psychological) processes involved or how they may contribute to a student's performance. Based on his or her (typically, unsystematic) observations, the researcher *selects* certain instances of certain behaviors of certain students for (typically, in-depth) scrutiny. The researcher then goes on to *prescribe* certain instructional procedures, materials/methods, or classroom small-group instructional strategies that follow from the scrutiny.

We have no problem with the *examine* phase of such research, and possibly not even with the *select* phase of it, inasmuch as all data collection and observation involve selection of one kind or another. We do, however, have a problem if this type of research is not properly regarded for what it is: namely, preliminary/exploratory, observational, hypothesis generating. Certainly in the early stages of inquiry into a research topic, one has to look before one can leap into designing interventions, making predictions, or testing hypotheses. To demonstrate the *possibility* of relationships among variables, one might also select examples of consistent participant cases. Doing so, however: (1) does not comprise sufficient evidence to document the existence of a relationship (see, for example, Derry et al., 2000); and (2) can result in unjustified interpretations of the kind that Brown (1992, pp. 162–163) attributes to Bartlett (1932) in his classic study of mis-remembering. With regard to the perils of case selection in classroom-intervention research, Brown (1992, p. 173) properly notes that "there is a tendency to romanticize research of this nature and rest claims of success on a few engaging anecdotes or particularly exciting transcripts. One of the major methodological problems is to establish means of conveying not only the selective and not necessarily representative, but also the more important general, reliable, and repeatable."

In the ESP model, departure from the researcher's originally intended purposes of the work (i.e., examining a particular instance or situation) is often forgotten and prescriptions for practice are made with the same degree of excitement and conviction as those based on investigations with credible, robust evidence. The unacceptability of the *prescribe* phase of the ESP research mode goes without saying: Neither variable relationships nor instructional recommendations logically follow from its application. The widespread use of ESP methodology in intervention research, and especially in education, was appropriately admonished now nearly 50 years ago by Carl Bereiter in making his compelling case for more empirical studies of the "strong inference" variety (Platt, 1964) in our field:

> Why has the empirical research that has been done amounted to so little? One reason . . . is that most of it has been merely descriptive in nature. It has been a sort of glorified "people-watching," concerned with quantifying the characteristics of this or that species of educational bird . . . . [T]he yield from this kind of research gets lower year by year in spite of the fact that the amount of research increases. (Bereiter, 1965, p. 96)

Although the research names have changed, the problems identified by Bereiter remain and ESP methodology based on modern constructs flourishes (see also Levin & O'Donnell, 1999, pp. 194–198; and Robinson, Levin, Thomas, Pituch, & Vaughn, 2007).

Additional Forms of Contemporary Intervention Research "Evidence"

In this section we single out for critical examination four other methods of empirical inquiry, along with their resulting forms of "evidence," which are thriving in psychological and educational intervention research today. These are the case study, the demonstration study, observational/correlational studies, and design research.

The Case Study

Case-study research—consisting of the intensive (typically, longitudinal) study and documentation of an individual's "problem" of interest, along with the (traditionally and typically unsystematic) introduction of various interventions designed to address the problem—is not a new methodology in psychology and education. Examples can be observed throughout the history of these disciplines, including the pioneering efforts of psychoanalyst Sigmund Freud, developmentalist Jean Piaget, and behaviorist B. F. Skinner. Although limitations of the case study have been recognized for some time, recommendations for improving case-study methodology have been advanced (see Kazdin, 1981, 2011; Kratochwill, 1985). It is not the methods of case-study research that are problematic, but rather the claims and generalizations for evidence-based practice that result from this methodology. An illustration of case-study application in research on treatment of children's disorders will alert the reader to the role that it can play in furnishing ancillary evidence for practice.

Reuther, Davis, Moree, and Matson (2011) reported the results of a case study in which a version of behavior therapy was used to treat a childhood disorder known as selective mutism. Selective mutism is an anxiety-related disorder in which children are unable to speak in social situations, such as in school and in the community. In this case study, Reuther et al. used a previously well-established treatment called modular cognitive-behavioral therapy (CBT), which includes such components as psycho-education, exposure, cognitive restructuring, social skills, and maintenance and relapse prevention (Chorpita, 2007, provides a treatment manual that features these components). Although up to the time of Reuther et al.'s (2011) study, there had been no clinical-trial assessments of CBT with respect to selective mutism, prior research on related childhood anxiety problems suggested that CBT was a reasonable treatment choice for this case. After implementing CBT over a period of 21 sessions, the authors reported that on measures of fear hierarchy ratings, self- and parent reports, and interviews with the child and parent, the child had improved and no longer met criteria for selective mutism. Moreover, follow-up assessment at 1 and 6 months showed that the improvements were maintained.

What can be concluded from this case study? In our opinion, little if anything from an internal validity perspective. In this regard, the study would not meet the design and evidence SCD standards of the WWC. However, among the variety of treatment procedures available for children experiencing selective mutism, behavior-therapy techniques have emerged as among the most successful, based on clinical research (Chorpita, 2007). In particular, CBT procedures have been investigated in a series of controlled single-case intervention studies with replication of findings across independent cases. The Reuther et al. (2011) case study demonstrated a CBT application to a new disorder and sets the occasion for future [and more tightly controlled and replicated (i.e., CAREful)] research on this childhood disorder.

TABLE 19.1 Levels of Inference Generally Associated With Various Research Methodology and Outcome Features (Adapted from Kratochwill et al., 1984)

Characteristics	*Low Inference*	*High Inference*
Type of data	Subjective data	Objective data
Planned vs. ex post facto	Ex post facto	Planned
Projections of performance	Acute problem	Chronic problem
Effect size	Small	Large
Effect impact	Delayed	Immediate
Number of participants	$N = 1$	$N > 1$
Heterogeneity of participants	Homogeneous	Heterogeneous
Standardization of treatment	Nonstandardized treatment	Standardized treatment
Integrity of treatment	No monitoring	Repeated monitoring
Impact of treatment	Impact on single measure	Impact on multiple measures
Generalization and follow-up assessment	No formal measures	Formal measures

Again, our main concern with case studies is related to the generalizations that are often made for practice. Within a proper context, case-study research may be useful in generating hypotheses for future well-controlled investigations (see, for example, Stanovich, 2007, pp. 55–56)—as was done in the Reuther et al. (2011) study. Moreover, not all case studies are alike on methodological dimensions and the researcher using these methods has available options for improving the inferences that can be drawn from such studies (Kratochwill, Mott, & Dodson, 1984). Table 19.1, adapted from Kratochwill et al. (1984), shows some of the methodological features that suggest levels of inference (varying from high to low) that can be applied to both the design of case studies and the interpretation of data from these investigations (see also Kazdin, 2011). Nevertheless, case studies fall into the "demonstration study" category (to be discussed next) and differ from another often-confused SCD, the systematically implemented and controlled single-case intervention study: (a) which was discussed earlier in relation to the WWC SCD Panel's design standards; and (b) for which replication and (in many instances) intervention randomization are critical features (see Kratochwill et al., in press; Kratochwill & Levin, 2010).

The Demonstration Study

Two ubiquitous examples of demonstration studies in educational contexts include: (1) an instructional intervention that is introduced within a particular classroom (with or without a nonintervention comparison classroom); and (2) an out-of-classroom special intervention "program" that is provided to a selected group of students. The critical issue here (which will be revisited shortly) is that with only one classroom receiving special instruction or only one group participating in a special program, it is not possible to separate the effects of the intervention or the program from the specific implementation of it.

J. Levin and M. Levin (1993) discuss interpretive concerns associated with the "evidence" derived from a demonstration study in the context of evaluating the outcomes of an academic retention program. They are encompassed in three CAREful-component questions in one: Was the program effective? With an emphasis on "effective," one can ask: "Relative to what?" for in many program evaluation studies frequently lacking is an appropriate *C*omparison (either with comparable nonprogram students or with participants' preprogram data). With an emphasis on "the," one can ask: Do you mean *this* single implementation of the program?" for generalization to other program cohorts or sites is not possible without an *A*gain and again replication component. Finally, with an emphasis on "program," one can ask: "Can other, nonprogram-related, factors account for the observed outcomes?" for without program randomization and control, one cannot readily *E*liminate other potential contributors to the effects. Levin, Levin, and Scalia's (1997) report of college retention program for academically at-risk minority students provides an example of a demonstration study. As with our previous case-study example, because of the uncontrolled nature of the study and the one-time implementation of the program, any of the documented positive outcomes associated with program participants cannot be regarded as either scientifically credible or generalizable to other implementations of the program. Moreover, even if a randomized nonprogram control group had been included, both to provide a *C*omparison of group outcomes and to *E*liminate other explanations for program-related effects, one still would not have been able to identify which ingredients of the multiple-component program (e.g., strategic course selection, excellent teachers, small-group supplemental instruction sessions, academic and personal support for students) were "active" or necessary and which ingredients were not (see also our discussion of Collins' (1992) hypothetical experiment in the Design Research section further on). In that sense, then, and as Levin et al. (1997, pp. 86–87) point out, a report of their particular program and its outcomes can indicate only "what happened" under a unique and favorable set of circumstances. It clearly is not an indication of "what to expect" if a similar program were to be implemented by others with other college students elsewhere.

Observational/Correlational Studies

In many observational/correlational educational research studies (sometimes referred to as "cross-sectional" or *ex post facto* studies), researchers often wish to evaluate the efficacy of instructional methods, materials, processes, or skills either by: (a) comparing preexisting groups of students who have or who do not have Method or Materials X; or (b) examining the correlation between the presence/absence of Process or Skill X and outcome(s) in a single group of students. In such studies, no purposeful intervention has been systematically introduced by an intervener to one group and not to the other (either randomly, according to CAREful research principles, or even nonrandomly). As Shadish et al. (2002, p. 18) have cautioned:

> In cross-sectional studies in which all the data are gathered on the respondents at one time, the researcher may not even know if the cause precedes the effect. When these studies are used for causal purposes, the missing design features can be problematic unless much is already known about which alternative interpretations are plausible, unless those that are plausible can be validly measured, and unless the substantive model used for statistical adjustment is well specified.

Distressingly, however, the incidence of educational prescriptions—such as "If children are provided with manipulatives while reading, their comprehension will increase" (Marley & Levin, 2011)—in observational and correlational (i.e., nonintervention) studies is not abating. To the contrary, the incidence may even be on the rise. In a survey of five of the most visible journals that publish primary research in the area of teaching and learning, it was found that of the 84 nonintervention-study articles published in these five journals in 2004, fully 43% of them offered prescriptive statements—up from 30% a decade earlier (Robinson et al., 2007). Moreover, Reinhart, Haring, Levin, Patall, and Robinson (2012) have recently reported that the percentage of nonintervention-study prescriptive statements in these same journals in 2010 remained at a high 46%.

Design Research

Also considered here is classroom-based design research (e.g., Barab & Squire, 2004; the Design-Based Research Collective, 2003), originally termed "design experiments" and popularized by Collins (1992) and by Brown (1992), and welcomed into the educational research community by Salomon (1995, p. 107) and by various research-funding agencies (e.g., Suter, 1999). In design research: (a) research is conducted in authentic contexts (e.g., in actual classrooms, in collaboration with teachers and other school personnel); and (b) the research design and procedures are not predetermined in the traditional sense, but rather instructional-design modifications are made "on the fly," as desired or needed.

Interestingly, upon closer inspection, one discovers that from a strict terminological standpoint, the original designation, "design experiments," neither had a "design" nor were they "experiments." In particular, in conventional research usage, "design" refers to a set of preexperimental plans concerning the specific conditions, methods, and materials to be incorporated in the study. In design research, however, any components may be altered by the researcher or teacher as the investigation unfolds, as part of "flexible design revision" (Collins, 1992, p. 18).

It may often be the case that the teacher or researchers feel a particular design is not working early in the school year. It is important to analyze why it is not working, and take steps to fix whatever appears to be the reason for failure (Collins, 1992, p. 18).

Similarly, in conventional research terminology, "experiment" refers to situations in which participants are randomly assigned to the two or more systematically manipulated and controlled conditions of a study (e.g., Campbell & Stanley, 1966). In design research, however (and as will be expanded upon shortly), appropriate randomization and control are conspicuously absent which, in turn, do not permit a credible attribution of outcomes to the intervention procedure(s) under investigation. Take, for example, Collins' (1992) description of a hypothetical design experiment (with numbers in square brackets added for identification in the subsequent paragraph):

> Our first step would be to observe a number of teachers, and to choose two who are interested in trying out technology to teach students about the seasons, and who are comparably effective [1], but use different styles of teaching: for example, one might work with activity centers in the classroom and the other with the entire class at one time [2]. Ideally, the teachers should have comparable populations of students [3] . . . . Assuming both teachers teach a number of classes, we would ask each to teach half her classes using the design we have developed [4]. In the other classes, we would help the teacher design her own unit on the seasons using these various technologies [5], one that is carefully crafted to fit with her normal teaching style [6]. (Collins, 1992, p. 19)

From this description, it can be seen that in design research there are numerous plausible alternative explanations for the observed outcomes that compete with the intervention manipulation of interest. Consider the following components of Collins' hypothetical study:

[1] How can "comparably effective" teachers be identified, let alone be defined?

[2] Teachers differing in "teaching style" differ in countless other ways as well; one, for example, might have brown hair and the other grey, which could actually be an age or years-of-experience proxy.

[3] Again, how are student populations "comparable" and how are they defined to be so?

[4]–[6] Assuming that the two teachers could both teach their respective classes in precisely the prescribed manner (a tall assumption for a within-teacher instructional manipulation of this kind) and that individualized teacher-style "crafting" could be accomplished (another tall assumption), any result of such a study would represent a confounding of the intervention manipulation and specific teacher characteristics (as alluded to in [2]), and so nothing would be learned about the effects of the instructional manipulations per se. What is worse, in the rest of Collins' (1992, p. 19) example the described instructional manipulation contains no less than *seven* sequentially introduced technology components. Consequently, even if teacher effects could be eliminated or accounted for, one would still have no idea what it was about the intervention manipulation that produced any outcome differences. Was it, for example, that students became more engaged by working on the computer, more attuned to measurement/data properties and accuracy by collecting information and entering it into a spreadsheet, more self-confident by interacting with students from other locations, more proficient writers through book production, etc., etc.? There is no way of telling, and telling is something that a researcher-as-intervention-prescriber should want, and be able, to do.

Design research certainly has both its advocates (e.g., Collins, Joseph, & Bielaczyc, 2004) and its detractors (e.g., Kelly, 2004). Those who regard intervention research's sole purpose as improving practice also often regard research conducted in laboratory settings as decontextualized and irrelevant to natural contexts (see Kazdin, 2003). In contrast, design research is, by definition, classroom- based and classroom-targeted. On the other side of the ledger, design research can be criticized on methodological grounds, as well as on the basis of design experimenters' potential to subordinate valuable classroom-instructional time to the (typically lengthy and incompletely defined) research agenda on the table. In our view, design research can play an informative role in preliminary stages of intervention research as long as the design researcher remembers that the research was designed to be "preliminary" when reporting and speculating about a given study's findings.[4] In fact, design research and other informal classroom-based studies are incorporated into the model of educational/psychological intervention research that we propose in a later section. On a related note, we heartily endorse Brown's (1992, pp. 153–154) research strategy of ping-ponging back and forth between classroom-based investigations and controlled laboratory experiments a "cross-fertilization between settings" (Brown, p. 153) for developing and refining contextually valid instructional theories (see also Kratochwill & Stoiber, 2000, for a similar view of research in school psychology). The reader must again be reminded, however, that scientifically credible operations (chiefly, randomization and control) are not an integral part of design research, at least not as Collins (1992) and Brown (1992) have conceptualized it.

Summary Comments

For much intervention research as it is increasingly being practiced today, we are witnessing a movement away from CAREful research principles, and even away from preliminary research models principally couched in selected observations and questionable prescriptions. Rejection of the scientific method and "quantitative" assessment may be leading to inadequate graduate training in rigorous research skills that are valued by many academic institutions and funding agencies. At the same time, it should not be forgotten that even "qualitatively" oriented researchers are capable of engaging in mindless mining of their data as well. Vanessa Siddle Walker (1999) distinguished between "data" and "*good* data," which, in our current terminology, translates as: "Not all evidence is equally credible."

Just as in other fields informed by bonafide empirical inquiry, in psychology and education we must be vigilant in dismissing "fantasy, unfounded opinion, 'common sense,' commercial advertising claims, the advice of gurus, testimonials, and wishful thinking [in our] search for the truth" (Stanovich, 2007, p. 202). Case studies, demonstration studies, observational/correlational studies, and design-based research have their place in the developmental stages of intervention research, as long as the researchers view such efforts as "preliminary" and adopt a "prescription withholding" stance when reporting the associated outcomes. We cannot imagine, for example, well-informed researchers and consumers taking seriously instructional prescriptions from someone whom proudly proclaims: "Let me tell you about the design-research study that I just conducted."

In the next section we offer some additional reflections on the character of contemporary educational/psychological intervention research. In so doing, we provide suggestions for enhancing the scientific integrity of intervention research training and the conduct of intervention research.

ENHANCING THE CREDIBILITY OF INTERVENTION RESEARCH

Educational/Psychological Research Versus Medical Research

High standards have been invoked for intervention outcome research in medicine. The evidence-based intervention movement was initiated in medical research in the United Kingdom and, as was noted earlier, was subsequently embraced by clinical psychology (Chambless & Ollendick, 2001; Weisz & Hawley, 2001), school psychology (Kratochwill & Shernoff, 2003), and certain areas of APA (e.g., American Psychological Association Presidential Task Force on Evidence-Based Practice, 2006; American Psychological Association Task Force on Evidence-Based Practice for Children and Adolescents, 2008). An editorial in the *New England Journal of Medicine* spells out in clear and certain terms the unacceptability of admitting anecdotes, personal testimony, and uncontrolled observations when evaluating the effectiveness of a new drug or medical treatment:

> If, for example, the Journal were to receive a paper describing a patient's recovery from cancer of the pancreas after he had ingested a rhubarb diet, we would require documentation of the disease and its extent, we would ask about other, similar patients who did not recover after eating rhubarb, and we might suggest trying the diet on other patients. If the answers

[4] For a personal anecdote of how researchers sometimes take studies of this kind and attempt to sneak them "through the back door" (Stanovich, 1999) into scholarly research journals, see Levin & O'Donnell (2000, p. 182).

> to these and other questions were satisfactory, we might publish a case report—not to announce a remedy, but only to suggest a hypothesis that should be tested in a proper clinical trial. In contrast, anecdotes about alternative remedies (usually published in books and magazines for the public) have no such documentation and are considered sufficient in themselves as support for therapeutic claims. Alternative medicine also distinguishes itself by an ideology that largely ignores biologic mechanisms, often disparages modern science, and relies on what are purported to be ancient practices and natural remedies . . . [H]ealing methods such as homeopathy and therapeutic touch are fervently promoted despite not only the lack of good clinical evidence of effectiveness, but the presence of a rationale that violates fundamental scientific laws—surely a circumstance that requires more, rather than less, evidence. (Angell & Kassirer, 1998, p. 839)

Angell and Kassirer (1998) call for scientifically based evidence, not intuition, superstition, belief, or opinion. Many would argue that psychological and educational intervention research are not medical research and that the former represent an inappropriate analog model for the latter. We disagree. Both medical and psychological/educational intervention research involve investigator-introduced manipulations withincomplex systems in which it is difficult to map out causal relationships. Reread the Angell and Kassirer excerpt, for example, substituting such words as "child" or "student" for "patient," "amelioration of a "conduct disorder" or "reading disability" for "recovery from cancer of the pancreas," "ingested a rhubarb diet" for "ingested a rhubarb diet," and so on. Just as medical research seeks prescriptions, so does psychological and educational intervention research; and prescription seeking should be accompanied by scientifically credible evidence to support those prescriptions (see, for example, Mayer, 2005; Murnane & Willett, 2011; Shavelson & Towne, 2002; Slavin, 2002). And, as former AERA president Michael Scriven poignantly queries in his contemplation of the future of educational research:

> Why is [scientifically credible methodology] good enough for medical research but not good enough for educational research? Is aspirin no longer working? (Scriven, 1997, p. 21)

Moreover, the kinds of researchable questions, issues, and concerns being addressed in the medical and psychological/educational domains are clearly analogous: Is one medical (educational) treatment better than another? Just as aspirin may have different benefits or risks for different consumers of it, so also may an instructional treatment. And just as new medical research evidence may prove conventional wisdom or traditional treatments to be incorrect (e.g., Goode, 1999; Hooper, 1999; Stein, 2010), the same is true of educational/psychological research evidence (e.g., Katsnelson, 2010; Levin & Pressley, 1983; U.S. Department of Education, 1986; Wong, 1995; see also Riehl, 2006). Citing the absence, to date, of research "breakthroughs" in psychology and education (in contrast to those that can be enumerated in medicine) is, in our view, insufficient cause to reject the analogy out of hand.

It is possible that many people's initial rejection of the medical model of research as an apt analog for psychological/educational research results from their incomplete understanding of what constitutes medical research. In the development of new drugs, clinical trials with humans proceed through three phases (NIH, 1998). In Phase I clinical trials, research is conducted to determine the best delivery methods and safe dosage levels (including an examination of unwanted side effects) of a drug. Phase II clinical trials address the question of whether the drug produces a desired effect. Phase III trials compare the effects of the new drug against the existing standard(s) in the context of carefully controlled randomized experiments. Thus, although medical research includes various forms of empirical inquiry, it culminates in a randomized comparison of the new drug with one or more alternatives to determine if, in fact, something new or better is being accomplished—see, for example, the criteria from the Clinical Psychology Task Force (Weisz & Hawley, 2001) for a similar view. The phases of clinical trials described here roughly parallel the "stages" in the model of educational research that we now propose.

A Stage Model of Educational/Psychological Intervention Research

Our vision of how to close one of intervention research's fundamental credibility gaps, while at the same time better informing practice, is presented in Figure 19.2's stage model of educational/psychological intervention research. In contrast to currently popular modes of intervention research inquiry and reporting, the present conceptualization: (1) makes explicit different research "stages," each of which is associated with its own assumptions, purposes, methodologies, and standards of evidence; (2) concerns itself with research credibility through high standards of internal validity; (3) concerns itself with research creditability through high standards of external validity and educational/societal importance; and most significantly (4) includes a critical stage that has heretofore been missing in the vast majority of intervention research, namely, a randomized "classroom trials" link (modeled after the

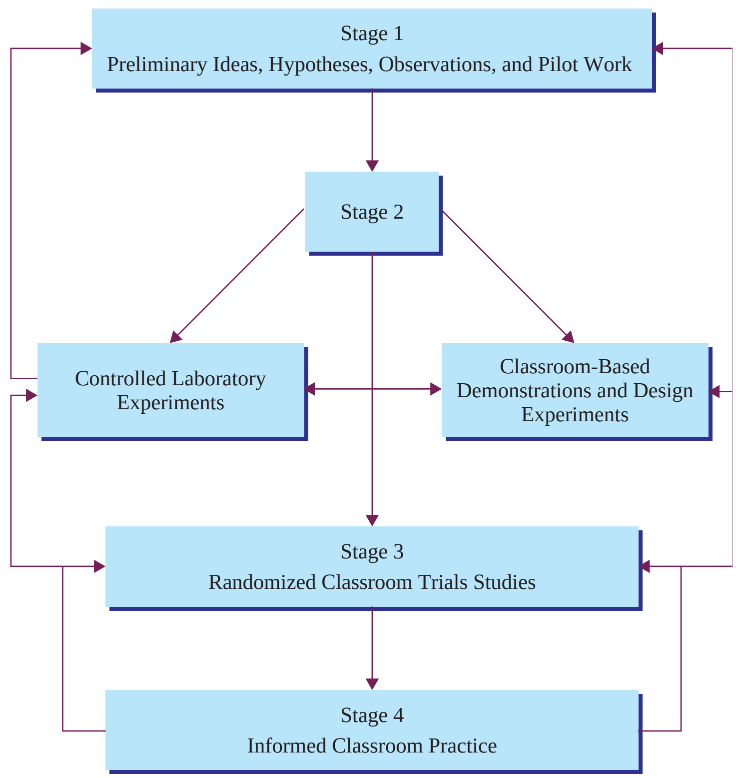


Figure 19.2 Stage model of educational/psychological intervention research (from Levin & O'Donnell, 1999). Reproduced by permission.

"clinical trials" stage of medical research) between the initial development and limited testing of the intervention and the prescription and implementation of it. Alternatively, Stage 3 could be referred to as an *instructional trials* stage, a *school trials* stage, or more generically, as an *educational trials* stage. To simplify matters, for the remainder of the chapter we will continue to refer to Stage 3 as the randomized *classroom* trials stage of credible intervention research studies.

Stages 1 and 2 of the Figure 19.2 model are likely familiar to readers of this chapter, as studies in those traditions comprise the vast majority of educational intervention research as we know it. In addition, throughout the chapter we have provided details of the two Stage 2 components of the model in our consideration of the research-first (controlled laboratory experiments) versus practice-first (case studies, demonstrations, observational/correlational studies, and design research) perspectives. Both classes of research are "preliminary," though in different complementary senses. The former (research first) are preliminary in that their careful scrutiny of interventions lacks an applied-implementation component, whereas the latter (practice first) are preliminary in that their intervention prescriptions are often not founded on scientifically credible evidence. Stage 1 and Stage 2 studies are crucial to developing an understanding of the phenomena that inform practice (Stage 4) but that first must be rigorously, complexly, and intelligently evaluated in Stage 3. Failure to consider possibilities beyond Stages 1 and 2 may result in a purposelessness to research, a temptation never to go beyond understanding a phenomenon and determining whether it is a stable phenomenon with genuine practice implications. The accumulation of applied scientifically credible evidence is precisely the function of the randomized classroom trials stage (Stage 3, highlighted in Figure 19.2) of the model. As in medical research, this process consists of an examination of the proposed treatment or intervention under realistic, yet carefully controlled, conditions (e.g., Angell & Kassirer, 1998).

Realistic conditions refer to the specific populations and contexts about which one wishes to offer conclusions regarding treatment efficacy (i.e., external validity desiderata). In medical research, the conditions of interest generally include humans (rather than animals), whereas in psychological and educational research, the conditions of interest generally include children in community settings and school classrooms (rather than isolated individuals).

In addition, in both medical and psychological/educational contexts, the interventions (e.g., drugs or instructional methods, respectively) must be administered in the appropriate fashion (dosage levels or instructional integrity, respectively) for a long enough duration for them to "take" and to permit the assessment of both the desired outcome (e.g., an improved physical or social/academic condition, respectively) and any unwanted side effects (adverse physical, cognitive, affective, or behavioral consequences). In a classroom situation, an appropriately implemented instructional intervention of at least a semester, or even a year, in duration would be expected to satisfy the "long enough" criterion.

"Carefully controlled conditions" refer to internally valid experiments based on the random assignment of multiple independent "units," "cases," or "replicates" to alternative treatment/intervention conditions. Again, in medical research the randomized independent units are typically humans, whereas in educational intervention research the randomized independent units are frequently small groups/classrooms/schools (Levin, 1985, 1992, 1994; McDonald, Keesler, Kauffman, & Schneider, 2006; Murnane & Willett, 2011; Phye, Robinson, & Levin, 2005). As with medical research, careful control additionally involves design safeguards to help rule out contributors to the effects other than the targeted intervention, such as including appropriate alternative interventions, incorporating "blind" and "double blind" intervention implementations (to the extent possible) so that child, teacher, therapist, and researcher biases are eliminated, and being responsive to all other potential sources of experimental internal invalidity (Campbell & Stanley, 1966; Shadish et al., 2002).

The randomized classroom trials stage of this model is sensitive to each of the earlier indicated CAREful research components, in that: (1) the inclusion of alternative interventions—including appropriately packaged standard methods and placebos, along with attention to recently documented negative-expectation "nocebos" (*Arizona Daily Star*, 2011a)—permits a meaningful *C*omparison when assessing the effects of the targeted intervention; (2) the use of multiple independent units (both within a single study and, ideally, as subsequent replication studies) permits generalization through the specified outcomes being produced *A*gain and again; and (3) with across-unit randomization of interventions (and assuming adequate control and appropriate implementation of them), whatever *R*elationship is found between the targeted intervention and the specified outcomes can be traced directly to the intervention because (4) with such randomization, control, and implementation, one is better able to *E*liminate all other potential explanations for the outcomes.

The randomized classroom trials stage of our proposed model possesses a number of critical features that are worth mentioning. These features represent the best of what CAREfully controlled and well-executed laboratory-based research has to offer applied and clinical research. First and foremost here is the inclusion of multiple units (or in single-case research designs, multiple phases, multiple within-phase observations per case, and additional case replications—see, for example, Kratochwill et al., in press; and Kratochwill & Levin, 1992) that are randomly assigned to receive either the targeted intervention or an acceptable alternative. For example, when "classrooms" comprise the units of treatment administration, the use of multiple independent classrooms is imperative for combating "evidence credibility" concerns arising from both methodological and statistical features of the research. Each of these will be briefly considered here (for additional discussion, see Baldwin, Murray, & Shadish, 2005; Campbell & Boruch, 1975; Levin, 1985, 1992, 1994, 2005; J. Levin & M. Levin, 1993; Murnane & Willett, 2011).

Methodological Rigor

Consider some examples from educational research to contextualize our perspectives on methodological rigor. In a once-typical instructional intervention study, the participants in one classroom would receive "new" instructional methods or materials (including combinations of these, multi-component versions, and systemic curricular innovations) while those in another classroom would receive either alternative or standard instructional methods/materials/curricula. One does not have to look very hard to find examples of this type of study in the traditional educational intervention research literature, as it is pervasive. The aforementioned Graziano et al. (1999) "piano lessons and spatial exercises" training study is an example of this methodological genre. The problem with such studies is that any resultant claims about intervention-produced outcomes are not credible, insofar as whatever effects are observed can be plausibly attributed to a myriad of other factors not at all connected with the intervention per se. In studies where there is only one classroom/teacher per intervention, for example, any potential intervention effects are inextricably confounded with classroom/teacher differences—even if "equivalence" can be demonstrated on a pretest. If students are not randomly assigned to classrooms and classrooms to interventions, intervention effects are confounded with selection biases as well. Indeed, as far as credible evidence is concerned, a reasonable case can be made that a "one classroom per intervention" study is just that, an individual "case." Accordingly, one-classroom-per-intervention studies fall into our earlier discussion of intervention "research" that in actuality is a classroom-based "demonstration."[5]

With the addition of sequential modifications of the instructional intervention, the previously discussed "design research" also resembles the "one classroom per intervention" prototype. Minor variations of that prototype include assigning a couple classrooms to each "intervention" condition (e.g., Brown, 1992) or having one or a few teachers alternately implement both "interventions" in a few classrooms (e.g., Collins, 1992). Unfortunately, numerous concerns (related to nonrandomization, contaminating teacher, student, classroom, and researcher effects, and invalid statistical analyses, among others), analogous to the ones raised here, are associated with such variations as well. Various methodological and statistical developments out of the behavior-analytic and clinical research traditions do, however, have the potential to enhance the scientific credibility of the "one or a few classrooms per intervention" study (e.g., Edgington & Onghena, 2007; Koehler & Levin, 1998; Kratochwill & Levin, 1992, 2010; Levin & Wampold, 1999; Shadish & Rindskopf, 2007) and, therefore, should be given strong consideration in classroom-based and other intervention studies.

Unfortunately, adding the sequential intervention-modification strategy of design research only serves to add confounding variables to the interpretive mix. Although some may regard confounding the effect of an intervention with other variables to be acceptable in a design experiment—"Our interventions are deliberately designed to be multiply confounded" (Brown, 1992, p. 167)—confoundings of the kind described here clearly are not acceptable in the classroom trials stage of educational intervention research. In Stage 3 of the model, the random assignment of multiple classrooms or other intact groups to interventions serves to counteract this methodological concern; for actual research examples, see Byrne and Fielding-Barnsley (1991); Duffy et al. (1987); Osana and Pitsolantis (in press), and Stevens, Slavin, and Farnish (1991).

Consistent with the earlier presented *C*omparison component of CAREful research, the need for including appropriate comparison classrooms (or other aggregates) is of paramount importance in the Stage 3 model. As Slavin (1999) forcefully points out in response to a critic advocating the documentation of an intervention's effectiveness not by a comparison with a nonintervention control condition but through the presentation of what seem to be "surprising" outcomes in the intervention condition:

> An experimental-control comparison between well-matched (or, ideally, randomly assigned) participants is to be able to provide powerful evidence for or against a causal relationship [attributable to the intervention], because the researcher establishes the experimental and control groups in advance, before the results are known, and then reports relative posttests or gains. In contrast, [the critic's] search for "surprising" scores or gains begins after the fact, when the results are already known. This cannot establish the effect of a given program on a given outcome; any of a thousand other factors other than the treatment could explain high scores in a given school in a given year. . . . If an evaluation has data on 100 schools implementing a given program but only reports on the 50 that produced the most positive scores, it is utterly meaningless. In contrast, a comparison of 10 schools to 10 well-matched control schools provides strong evidence for or against the existence of a program impact. If that experimental-control comparison is then replicated elsewhere in a series of small but unbiased studies, the argument for a causal relationship is further strengthened. (Slavin, 1999, pp. 36–37)

Slavin's hypothetical example should evoke readers' memories of the perils and potential for deception that are inherent in the Examine aspect of the earlier-presented ESP model of educational intervention research. The example also well illustrates the adapted adage: A randomized experiment is worth more than 100 school demonstrations!

Analytic Appropriateness

Early and often in the history of psychological and educational research, much has been written on the inappropriateness of researchers statistically analyzing the effects of classroom-implemented interventions as though the interventions had been independently administered to individual students (e.g., Baldwin et al., 2005; Barcikowski, 1981; Levin, 1992, 2005; Lindquist, 1940; Page, 1965; Peckham, Glass, & Hopkins, 1969). That

[5]An unfortunate recent example of this mode of one-classroom-per-intervention, multiply confounded "research" is a study reported in the influential journal, *Science* (Deslauriers, Schelew, & Wieman, 2011), which led to immediate media claims that the authors (one of whom is a Nobel laureate physicist) had unearthed a highly effective instructional approach for teaching college-level physics (e.g., *Arizona Daily Star*, 2011b).

is, there is a profound mismatch between the units of intervention administration (groups, classrooms) and the units of statistical analysis (children, students) and conducting child/student-level statistical analyses in such situations typically results in a serious misrepresentation of both the reality and the magnitude of the intervention effect.[6] Consider, for example, a hypothetical treatment study in which one classroom of 20 students receives a classroom management instructional intervention and another classroom of 20 students receives standard classroom protocol. It is indisputably incorrect to assess the intervention effect in that study by means of a conventional student-level *t* test, analysis of variance, chi-square test, or other statistical procedures that assume that 40 independently generated student outcomes comprise the data. Analyzing the data in that fashion will produce misleading statistical inferences and conclusions.

Even today most "one group per intervention" (or even "a couple groups per intervention") researchers continue to adopt units-inappropriate analytic practices, in spite of the earlier noted cautions and evidence that such practices lead to dangerously misleading inferences (e.g., Graziano et al., 1999). In a related context, Muthen (1989, p. 184) speculates on the reason for researchers' persistent misapplication of statistical procedures: "The common problem is that measurement issues and statistical assumptions that are incidental to the researchers' conceptual ideas become stumbling blocks that invalidate the statistical analysis."

In the randomized classroom trials stage of the model, the critical "analytic appropriateness" issue can be dealt with through the inclusion of multiple randomized units (e.g., multiple classrooms randomly assigned to intervention and control conditions) in conjunction with the application of statistical models that are both valid and sensitive to the intervention-assignment scheme of the experiment (e.g., Goldstein, 2011; Raudenbush & Bryk, 2002). Relatedly, in the medical and health fields, group-randomized intervention trials (Braun & Feng, 2001; Murnane & Willett, 2011) are referred to as *cluster randomization trials* (e.g., Donner & Klar, 2000), with the corresponding pitfalls of invalid statistical analyses well documented. The number of experimental units to be included in a given study is not a specified constant. Rather, that number will vary from study to study as a function of substantive, resource, and statistical power considerations (e.g., Barcikowski, 1981; Levin, 1997a, 2005; Levin & Serlin, 1993; Raudenbush & Liu, 2000), as well as of the scope of curricular policy implications associated with the particular intervention. In addition, appropriate statistical methods to accompany multiple-baseline and other "few units per intervention" single-participant designs (alluded to earlier) are now available (see, for example, Edgington & Onghena, 2007; Koehler & Levin, 1998; Levin, Lall, & Kratochwill, 2011; Marascuilo & Busk, 1988; Wampold & Worsham, 1986).

Two additional critical features of the randomized classroom trials stage of Figure 19.2 are now indicated.

Intervention-Effect Robustness

The use of multiple randomized units in the randomized classroom trials stage permits legitimate intervention-effect generalizations across classrooms, teachers, and students—something that is not legitimate in the prototypical intervention study. With the additional feature of random selection of groups or classrooms within a school, district, or other "population," statistical analyses that permit even grander generalizations are possible (e.g., Raudenbush & Bryk, 2002), a desirable and defining characteristic of Slavin's (1997) proposed "design competition" for instructional interventions.[7] Finally, replication of the randomized classroom trials stage of the model, across different sites and with different investigators, increases one's degree of confidence in the reality, magnitude, and robustness of the intervention effect. In summary, each of the just-mentioned sampling augmentations of the randomized classroom trials stage can be considered in relation to enhancing the research's external validity.

Interaction Potential

The randomized classroom trials stage lends itself not just to generalization, but also to specificity, in the form

[6]As an interesting aside, *units of analysis* is another term with a specific statistical meaning but that is now being casually used in the educational research literature to refer to the researcher's substantive "grain-size" perspective: the individual student, the classroom collective, the school, the community, and so on (see, for example, Cobb & Bowers, 1999, pp. 6–8). In addition, with the advent of modern quantitative-analysis tools—hierarchical linear models (HLM), in particular (e.g., Goldstein, 2003; Raudenbush & Bryk, 2002)—the term *units of analysis* has been disappearing from the statistical lexicon.

[7]A "design competition" should not be confused with a "design experiment/design research," a confusion that has already occurred in the literature. The critical attributes of the latter have been discussed earlier in this chapter; those of the former will be discussed in a following section.

of determining whether a particular intervention is better suited to certain kinds of groups, classrooms, teachers, or students than to others. With one unit per intervention and conventional analyses, investigating intervention-by-characteristics interactions is not possible, or at least not possible without the methodological shortcomings and statistical assumption violations mentioned earlier. Just as different drugs or medical treatments may be expected to affect different patients differently, different classroom interventions likely have different effects on students differing in academic ability, aptitude, motivational levels, or demographic characteristics. The same would be expected of instructional interventions delivered by teachers with different personal and teaching characteristics. That is, one size might not fit all (Graesser & Hu, 2011; Salomon & Almog, 1998, p. 24), but researchable individual-differences questions can readily be incorporated into, and investigated in, the randomized classroom trials stage of educational intervention experiments (e.g., Levin, 1992, 2005; Levin & Peterson, 1984; Murnane & Willett, 2011; Raudenbush & Bryk, 2002); for an actual research example, see Copeland (1991). Included in this analytic armament are adaptations for studying intervention by outcome-measure interactions, changes in intervention effectiveness over time, and other large- or small-scale classroom-based multivariate issues of interest (see also Levin & Wampold, 1999).

What is "random" in randomized classroom trials studies? It is important to clarify exactly what needs to be "random" and controlled to yield scientifically credible unit-based evidence, for we have witnessed substantial confusion among intervention researchers concerning how to meet standards of internal, as opposed to external, validity in such studies. Reiterating that high internal validity per se is what makes an empirical study scientifically credible, we point out that in randomized classroom trials research:

- Classrooms and teachers do not need to be randomly selected to participate in the study.
- Student participants do not need to be randomly assigned to classrooms.
- The only aspect that must be random is the assignment of candidate units (e.g., groups, classrooms, schools) to the different intervention conditions, either across all units or in a matched-unit fashion. By "candidate," we are referring to all units for which there is a priori agreement to be included in the study, which implies accepting the fact that there is an equal chance of each unit's being assigned to any of the study's specified intervention conditions.[8] A "wait-list" or "crossover" arrangement (e.g., Cook & Campbell, 1979; Levin, 1992; Shadish et al., 2002) can also be implemented as a part of the nontargeted-intervention units' assignment.
- Scientifically credible studies based on whole unit random assignment operations can be performed on targeted participant subgroups. For example, classrooms containing both learning-disabled and nondisabled students could be randomly assigned to intervention conditions, with the focus of the study's intervention(s) being on just the former student subgroup.
- When either out-of-classroom or unobtrusive within-classroom interventions can be administered, within-classroom blocked random assignment of units to intervention conditions represents a scientifically credible strategy—for actual research examples, see Kratochwill, McDonald, Levin, Scalia, & Coover (2009) and Kratochwill, McDonald, Levin, Youngbear-Tibbetts, & Demaray (2004).
- Even if units are *initially* assigned to interventions randomly (as indicated above), *terminal* conditions-composition differences resulting from participant or group attrition can undermine the scientific credibility of the study (see, for example, the previously discussed Graziano et al., 1999, music/spatial ability training study). In such cases, analyses representing different degrees of conservatism should be provided, with the hope of obtaining compatible evidence.

An important addendum is that statistical adjustments and controls (e.g., analysis of covariance, path models, HLM, structural equation modeling [SEM], propensity score analysis) generally do not represent acceptable substitutes for situations in which random assignment of classrooms to intervention conditions cannot be effected. Although this point has been underscored by statisticians and methodologists throughout the history of educational/psychological research (e.g., Elashoff, 1969; Huitema, 1980; see also Murnane & Willett, 2011), researchers continue to believe that sophisticated statistical tools can resurrect data from studies that are inadequately designed and executed. In our earlier chapter in the 2003 *Handbook*, we provided a quote by Cliff (1983) on this caveat. Here, we provide two more quotes, one

[8]As an alternative to random assignment, a sophisticated multivariable computerized matching process known as design-adaptive allocation (e.g., Aickin, 2009) has been proposed for assigning units to experimental conditions in an equitable fashion.

offered near the beginning of the present-day modeling "revolution" and one of more recent vintage (for discussion of such modeling techniques and their purported warrants and limitations, see Kline, 2011; Robinson & Levin, 2010; and Rodgers, 2010; and for a more technical statistical discussion, see Pearl, 2011).[9]

> Major problems for users are generated by the language with which causal modeling is commonly discussed. Such models are said to express "causal" relations among variables, and users are sometimes tempted to presume that confirmation of a causal model is sufficient evidence to presume the presence of a causal relation. But the evidence with which such models are tested is merely associational, or in the best case associational and temporal; thus, the strongest conclusion that one can come to when assessing a causal model is that one has correctly predicted the patterning of observed, associational (and possibly temporal) relations. Readers do not have to be reminded that "correlation does not imply causality," but causal modelers are occasionally tricked into true belief by the word "causal." . . . However complex the model and study, it is quite possible that other variables the user has failed to consider would account for the relations observed; hence, this would invalidate causal conclusions. (Biddle & Marlin, 1987, p. 9)

> [J]ust as correlation does not imply causation, statistical causal modeling does not prove causation either. It is why Wilkinson and the Task Force on Statistical Inference (1999) emphasize that use of SEM computer programs "rarely yields any results that have any interpretation as causal effects" (p. 600) (Kline, 2005, p. 95) . . . . Of the 44 ways to fool yourself with SEM, #44 was interpret estimates of relatively large direct effects from a structural model as "proof of causality." (Kline, 2005, p. 324)

When random assignment of units to interventions has been used, however, the concurrent application of analysis of covariance or other statistical adjustment/equating techniques is entirely appropriate and may prove to be analytically advantageous (e.g., Levin & Serlin, 1993; Murnane & Willett, 2011)—for actual research examples, see Torgesen, Morgan, and Davis (1992) and Whitehurst et al. (1994).

Summary Comments

Conducting randomized classroom trials studies is not an easy task. We nonetheless claim that: (a) randomized experiments are not impossible (or even impractical) to conduct; and so (b) educational researchers must begin adding these to their investigative repertoires to enhance the scientific credibility of their research and research-based conclusions. Exemplary randomized classroom instructional research can be identified in the fields of reading (e.g., D. Fuchs et al., 2001; Mathes et al., 2005) and mathematics (e.g., L. Fuchs et al., 2005). At the same time, classroom-based research (and its resultant scientific credibility) can be adversely affected by a variety of real-world "plagues," including within-classroom treatment integrity, between-classroom treatment overlap and contagion, construct validity, as well as other measurement issues (e.g., Cook & Campbell, 1979; D'Agostino, 2005; Nye, Hedges, & Konstantopoulos, 2000). In addition, a variety of external validity caveats—superbly articulated in a persuasive treatise by Dressman (1999)—must be heeded when attempting to extrapolate educational research findings to educational policy recommendations. Within the past decade, highly prescriptive standards been adopted for the reporting of randomized controlled trials (RCT) research in the fields of medicine (Moher, Schulz, & Altman, 2001) and psychology (American Psychological Association Publications and Communications Board Working Group on Journal Article Reporting Standards, 2008).

In addition, a commendable effort to critique, and to improve, the quality of educational-policy research is evident in the regularly released reports of the National Education Policy Center at the University of Colorado at Boulder (http://nepc.colorado.edu): The Center's mission is to "produce and disseminate high-quality, peer-reviewed research to inform education policy discussions. We are guided by the belief that the democratic governance of public education is strengthened when policies are based on sound evidence" (National Education Policy Center, 2011). The earlier mentioned WWC also regularly releases summary documents evaluating the research contributing to the evidence base underlying various educational intervention programs, such as reading (e.g., *Sound Partners*, http://ies.ed.gov./ncee/wwc/reports/beginning_reading/sound_partners/index.asp; *Great Books*, http://ies.ed.gov./ncee/wwc/reports/adolescent_literacy/great_books/index.asp) and mathematics (e.g., *Core-Plus Mathematics*, http://ies.ed.gov./ncee/wwc/reports/hs_math/core_plus/index.asp).

There can be no denying that in contrast to the independent and dependent variables of the prototypical laboratory experiment, the factors related to school or classroom outcomes are complex and multidimensional (Graesser & Hu, 2011). Yet, others have argued

[9]Thanks to colleague and collaborator, Daniel Robinson, for alerting us to these two sources.

compellingly that to understand the variables (and variable systems) that have implications for social policy, randomized experiments should, and can, be conducted in realistic field settings (e.g., Boruch, 1975, 2007; Campbell & Boruch, 1975; Levin, 2005; Mark & Lenz-Watson, 2011; Mosteller & Boruch, 2002). Here we present a similar argument for more carefully controlled classroom-based research on instructional and other educational/psychological interventions.

Implementing a Randomized Classroom Trials Study

Is there a need for either small- or larger-scale randomized intervention studies? Have any instructional interventions advanced to the point where they are ready to be evaluated in well-controlled classroom trials? Or, as was alluded to earlier, are such implementation-and-evaluation efforts the sole property of medical research's clinical trials? Yes, yes, and no, respectively, and the time is ripe to demonstrate it.

A similar research sequence could be followed in moving beyond classroom description, laboratory research, and "one unit per intervention" studies to help settle the whole-language versus phonemic-awareness training wars in reading instruction (e.g., Pressley & Allington, 1999), to prescribe the most effective classroom-based reading and mathematics instructional techniques (e.g., Carlson & Levin, 2012; Pressley et al., 1992), to investigate issues related to optimal instructional media and technologies (e.g., Salomon & Almog, 1998), and the like—the list goes on and on. That is, there is no shortage of randomized classroom-intervention research leads to be explored, in virtually all content domains that promote cognitive or behavioral interventions. Beyond the classroom, school and community trials experiments can help to bolster claims about intervention efforts at those levels. In addition to a perusal of the usual scholarly syntheses of research, all one needs do is to take a look at something such as the Institute of Education Sciences (IES) *What Works Clearinghouse* website (http://ies.ed.gov/ncee/wwc/) or P. Stanovich and K. Stanovich's (2003) informative resource document for research-based candidates with the potential to have a dramatic positive impact on instructional outcomes, classroom behavior, and general cognitive development. Randomized classroom trials research can provide the necessary credible and creditable evidence to realize that potential.

A recent instantiation of the foregoing discussion may be found in WWC's December 2011 "Quick Review" of Goodson, Wolf, Bell, Turner, and Finney's (2010) PAVE vocabulary development program for kindergartners (http://ies.ed.gov/ncee/wwc/pdf/quick_reviews/kpave_120611.pdf):

> **What is this study about?**
>
> The study examined whether exposure to Kindergarten PAVEd for Success, a vocabulary instruction program, improved expressive vocabulary of kindergartners. The study analyzed data for nearly 1,300 kindergarten students in 64 schools serving predominantly rural and high-poverty youth in the Mississippi Delta region and surrounding areas.
>
> Eligible schools were grouped by their existing core language arts curriculum and then randomly assigned within these groups to either supplement the core curriculum with the Kindergarten PAVEd for Success program or not. At each school, the study followed the achievement of a random sample of 10 students in two randomly selected classrooms.
>
> The primary study outcome was expressive vocabulary, as measured using the standardized Expressive Vocabulary Test–2nd Edition. The study assessed the Kindergarten PAVEd for Success program's effectiveness by comparing the expressive vocabulary of students in the treatment and control groups at the end of the school year.
>
> **What did the study find?**
>
> Kindergarten students in schools using Kindergarten PAVEd for Success as a supplement to regular literacy instruction performed better than kindergarten students in control schools on expressive vocabulary. The estimated effect size was 0.14, a statistically significant result.
>
> The authors reported that students who received Kindergarten PAVEd for Success instruction were one month ahead in vocabulary development at the end of kindergarten compared with students in the control group.
>
> **WWC Rating**
>
> The research described in this report meets WWC evidence standards. Strengths: The study is a well-implemented randomized controlled trial.

Commitment of Federal Funds to Randomized Classroom Trials Research

The notions that we have been advancing are quite compatible with Stanovich's (2007, pp. 55, 133–135) discussion of the importance of research progressing from early to later stages, producing, respectively, "weaker" and "stronger" forms of causal evidence (see also Table 19.1). The notions are also in synchrony with the final evaluative phase of Slavin's (1997) recommended design competitions, in which educational problems are agency-identified and research bidder plans to solve them submitted. With respect to that evaluative phase (which roughly corresponds to our randomized classroom trials stage), Slavin writes:

> Ideally, schools for the third-party evaluations would be chosen at random from among schools that volunteered to use the program being evaluated. For example, schools in a given district might be asked to volunteer to implement a new middle school model. This offer might be made in 5 to 10 districts around the country: some urban, some suburban, some rural, some with language-minority students, some large schools, some small ones, and so on. Fifty schools might be identified. Twenty-five might be randomly assigned to use the program and 25 to serve as controls (and to implement their current programs for a few more years). Control schools would receive extra resources, partly to balance those given to the experimental schools and partly to maintain a level of motivation to serve as control groups. (Slavin, 1997, p. 26)

The random assignment of volunteering schools to the program and control conditions, along with the allocation of additional resources to the control schools (see, for example, J. Levin & M. Levin, 1993), exhibits a concern for the research's internal validity. Additionally, the random sampling of schools exhibits a concern for the research's external validity and also permits an investigation of program effectiveness as a function of specific school characteristics. Multiple high-quality randomized school or classroom trials studies of this kind would do much to improve both public and professional perceptions of the low-quality standards that accompany educational research today (e.g., Mayer, 2005; Sabelli & Kelly, 1998; Sroufe, 1997). Incorporating and extending the knowledge base provided by smaller-scale Stage 2 empirical studies (e.g., Hedges & Stock, 1983), the long-running Tennessee Project STAR randomized classroom experiment investigating the effects of class size on student achievement (e.g., Nye et al., 2000) is a prominent example of scientifically credible research that has influenced educational policy nationwide (e.g., Biddle & Berliner, 2002; Finn, Gerber, Achilles, & Boyd-Zaharias, 2001; Murnane & Willett, 2011). The same can be said of the Success for All randomized schools experiments investigating the effects of systemic reform on student academic outcomes in schools serving traditionally low-achieving student populations (e.g., Borman, 2007; Slavin, Madden, Dolan, & Wasik, 1996). Of much older vintage, an illustration of a scientifically credible intervention with educational creditability is Harvard Project Physics, a randomized schools experiment based on a national random sample, in which an innovative high school physics curriculum was carefully implemented and evaluated (e.g., Walberg & Welch, 1972).

Are federal funding agencies willing to support randomized classroom trials ventures? As was convincingly argued for by the National Science Foundation at the dawning of the 21st century:

> At one end of the continuum, research is defined by researcher questions that push the boundaries of knowledge. At the other end of the continuum, research is defined by large-scale and contextual experiments, defined by implementation questions that frame robust applications . . . What is needed now, and what NSF is actively exploring, is to move ahead simultaneously at both extremes of the continuum. Basic learning about the process of learning itself—innovative R&D in tackling increasingly complex content and in the tools of science and mathematics education—informs and must be informed by applied, robust, large-scale testbed implementation research. (Sabelli & Kelly, 1998, p. 46)

Such ventures, which include randomized classroom trials investigations, appear to be exactly what certain educational/psychological research agencies (e.g., NSF, IES) have explicitly demanded, and heavily funded, in recent years. Thus, in contrast to detractors' periodic assertions that the medical research model does not map well onto the educational research landscape, we assert that randomized classroom trials studies have much to recommend themselves and, as a consequence, have gained widespread federal support.

Additional Comments

We conclude this section with five comments. First, we do not mean to imply that randomized classroom trials studies are appropriate for *all* areas of intervention research inquiry, for they most certainly are not (see, for example, Eisner, 1997). Systematic observation, rich description, and relationship documentation, with no randomized classroom component, may well suffice for characterizing many classroom processes and behaviors of both practical and theoretical consequence On the other hand, when it comes to implementing instructional and behavioral interventions (e.g., alternative teaching methods, learning strategies, classroom management programs) and other school- or other system-based "innovations," randomized classroom trials studies could go a long way toward responding to then Assistant Secretary of Education McGuire's (1999) call for rigorous educational research that "readily inform[s] our understanding of a number of enduring problems of practice." Fortunately, and as was just noted, in recent years: (a) the federal government has been promoting the push for randomized-classroom trials and related scientifically credible studies in their research funding priorities; and (b) IES has sponsored summer workshops to educate researchers in such topics as RCTs/cluster-randomized trials studies and single-case intervention studies that incorporate rigorous research methodology and data analyses.

Second, conducting a scientifically credible randomized classroom trials study does not preclude the adoption of other forms of educational/psychological research inquiry within the same study. In fact, some of the most penetrating and potentially informative investigative findings follow from the utilization of multiple/complementary research methods (Green et al., 2006) within a single study, in an attempt to fit together various pieces of the "intervention effectiveness" puzzle. For example, bolstering a large-scale classroom trials study with in-depth classroom observations of students and teachers, interviews and surveys of teachers, students, and parents, and the like can yield valuable information about intervention-implementation successes or failures at the school, classroom, and individual student levels. In addition, as one of us has noted previously (Levin, 2005, p. 23), smaller-scale randomized "microexperiments" can be conducted with selected subgroups or individual students within a large-scale randomized classroom trials study to investigate ancillary research questions that were not the primary foci of the study. Levin et al. (2011, pp. 74–75) provide a hypothetical example of how a randomized single-case experiment might have been incorporated into a large randomized within-classrooms behavioral intervention study to assess the effectiveness of a mathematics instructional intervention (Kratochwill et al., 2004).

Third, if we are to understand the strengths, weaknesses, and potential roles of various modes of empirical inquiry (e.g., observational/correlational studies, surveys, controlled laboratory experiments, design research), we need an overall model to represent the relationships among them. For Figure 19.2 to be such a model, one must believe that it is possible to have a generalized instructional intervention that can work in a variety of contexts. Testing the comparative efficacy of such an intervention would be the subject of a Stage 3 randomized classroom trials investigation. A substantive example that readily comes to mind is collaborative learning, an instructional strategy that has been shown to be effective in a variety of student populations and situations and across time (see, for example, O'Donnell, Hmelo-Silver, & Erkens, 2006). For those who believe that interventions can only be very population- and situation-specific, a unifying view of the reciprocal contributions of various research methodologies is difficult to promote.

Fourth, along with acknowledging that the classroom is typically a nest of "blooming, buzzing confusion" (Brown, 1992, p. 141), it should also be acknowledged that in the absence of Figure 19.2's Stage 3 research the blooming, buzzing confusion will be in a researcher's interpreting which classroom procedures or features produced which instructional outcomes (if, indeed, any were "produced" at all). In that regard, we reiterate that randomized classroom trials research is equally applicable and appropriate for evaluating the effects of single-component, multiple-component, and systemic intervention efforts alike. With the randomized classroom trials stage, at least a researcher will be able to attribute outcomes to the "intervention" (however tightly or loosely defined) rather than to other unintended or unwanted characteristics (e.g., teacher, classroom, or student effects).

Finally, and also in reference to Brown's (1992, p. 141) "blooming, buzzing confusion" comments directed at classroom-based research, we note that not all research on teaching and learning is, or needs to be, concerned with issues of teaching and learning *in classrooms*. Consider, for example, the question of whether musical knowledge and spatial ability foster the development of students' mathematical skills. That question does not require any classroom-based intervention or investigation for it to be answered. In fact, addressing the question in classroom contexts, and certainly in the manner in which the research has been conducted to date (Jenkins, 2001), may serve to obfuscate the issue more than resolve it. Alternatively, one need not travel far afield to investigate the potential of individually based interventions for ameliorating children's psychological and conduct disorders. Controlled large-scale assessments of the comparative effectiveness of various drug or behavioral therapies could be credibly managed within the randomized classroom (or community) trials stage of the Figure 19.2 model (see, for example, COMMIT Research Group, 1995; Goode, 1999; Peterson, Mann, Kealey, & Marek, 2000; Wampold et al., 1997). Adapting Scriven's (1997, p. 21) aspirin question here: Is the individual administration of therapeutic interventions applicable only for treating medical, and not educational, problems?

Closing CredibilityArguments

So, educational intervention research, whither thou goest? By the year 2020, will educational researchers still regard such methodologies as the ESP investigation, the demonstration study, and design research as credible evidence producers and regard the information derived from them as "satisficing" (Simon, 1955)? Or are there enough among us who will fight for credible evidence-producing methodologies, contesting incredible claims in venues wherein recommendations based on intervention "research" are being served up for either public or professional consumption?

A similar kind of "soul searching" related to research purposes, tools, and standards of evidence has been taking place in other social-sciences academic disciplines as well (e.g., Angrist & Pischke, 2010; Azar, 1999; Thu, 1999). Grinder (1989) described a literal "fallout" observed in the field of educational psychology as a result of researchers' perceived differences in purposes: In the 1970s and 1980s, many researchers chose to withdraw from educational psychology and head in other disciplinary directions. In the last generation or so, we have seen that sort of retreat in at least three professional organizations with a direct connection to education and psychology. Perceiving the American Psychological Association as becoming more and more concerned with clinical and applied issues, researchers aligned with the scientific side of psychology helped to form the Association for Psychological Science (APS, initially named the American Psychological Society in 1988). Similarly, in 1993, International Reading Association researchers and others who wished to focus on the scientific study of reading (rather than on reading practitioners' problems) founded a professional organization to represent that focus, the Society for the Scientific Study of Reading (SSSR). Most recently, in 2005, there was a migration of those dedicated to improving the scientific credibility of educational research to the Society for Research on Educational Effectiveness (SREE) from AERA. The scientifically grounded journals associated with these three organizations are, respectively, *Psychological Science*, *Scientific Studies of Reading*, and the *Journal of Research on Educational Effectiveness.*

Our message is a simple one: When it comes to recommending or implementing educational, clinical, and social interventions based on "research," standards of evidence credibility must occupy a position of preeminence. The core of the investigative framework that we propose here is not new. Many educational/psychological researchers and methodologists concerned with the credibility of research-derived evidence have offered similar suggestions for years, if not decades: Harken back to Bereiter's (1965) trenchant analysis of the situation. Why, then, do we believe it important, if not imperative, for us to restate the case for scientifically credible intervention research at this time? A frightening state of affairs still currently exists within the domain of educational/psychological intervention research. It is time to convince the public, the press, and policy makers alike of the importance of credible evidence derived from CAREfully conducted empirical investigations, delineating the characteristics critical to both its production and recognition. In this chapter, we have taken a step toward that end by first attempting to convince educational/psychological intervention researchers of the same.

REFERENCES

Abelson, R. P. (1995). *Statistics as principled argument*. Mahwah, NJ: Erlbaum.

Aickin, M. (2009). A simulation study of the validity and efficiency of design-adaptive allocation to two groups in the regression situation. *International Journal of Biostatistics, 5*(1), Article 19.

American Psychological Association Presidential Task Force on Evidence-based Practice (2006). Evidence-based practice in psychology. *American Psychologist, 61,* 271–285.

American Psychological Association Publications and Communications Board Working Group on Journal Article Reporting Standards (2008). Reporting standards for research in psychology: Why do we need them? What might they be? *American Psychologist, 63,* 839–851.

American Psychological Association Task Force on Evidence-Based Practice for Children and Adolescents (2008). *Disseminating evidence-based practice for children and adolescents: A systems approach to enhancing care*. Washington, DC: American Psychological Association.

Angell, M., & Kassirer, J. P. (1998). Alternative medicine: The risks of untested and unregulated remedies. *New England Journal of Medicine, 339,* 839–841.

Angrist, J. D., & Pischke, J-S. (2010). The credibility revolution in empirical economics: How better research design is taking the con out of econometrics. *Journal of Economic Perspectives, 24*(2), 3–30.

Arizona Daily Star. (2011a, March 1). Scientists find "nocebo" effect. Tucson.

Arizona Daily Star (2011b, May 14). Study: Technique used in teaching more important than who teacher is. Tucson.

Azar, B. (1999). Consortium of editors pushes shift in child research method. *APA Monitor, 30*(2), 20–21.

Baldwin, S. A., Murray, D. M., & Shadish, W. R. (2005). Empirically supported treatments or Type I errors?: Problems with the analysis of data from group-administered treatments. *Journal of Consulting and Clinical Psychology, 73,* 924–935.

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences, 13,* 1–14.

Barcikowski, R. S. (1981). Statistical power with group mean as the unit of analysis. *Journal of Educational Statistics, 6*, 267–285.

Barlow, D. H. (2010). Negative effects from psychological treatments: A perspective. *American Psychologist, 65,* 13–20.

Barlow, D. H., Nock, M. K., & Hersen, M. (2009). *Single case experimental designs: Strategies for studying behavior change* (3rd ed.). Boston, MA: Allyn & Bacon.

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge, UK: Cambridge University Press.

Bereiter, C. (1965). Issues and dilemmas in developing training programs for educational researchers. In E. Guba & S. Elam (Eds.), *The training and nurture of educational researchers* (pp. 95–110). Bloomington, IN: Phi Delta Kappa.

Biddle, B. J., & Berliner, D. C. (2002, February). Small class size and its effects. *Educational Leadership,* 13–23.

Biddle, B. J., & Marlin, M. M. (1987). Causality, confirmation, credulity, and structural equation modeling. *Child Development, 58,* 4–17.

Borman, G. D. (2007). Final reading outcomes of the national randomized field trial of success for all. *American Educational Research Journal, 44,* 701–731.

Boruch, R. F. (1975). On common contentions about randomized field experiments. In R. F. Boruch & H. W. Riecken (Eds.), *Experimental testing of public policy* (pp. 107–145). Boulder, CO: Westview Press.

Boruch, R. F. (2007). Encouraging the flight of error: Ethical standards, evidence standards, and randomized trials. *New Directions in Evaluation, 113,* 55–73.

Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. Princeton, NJ: Carnegie Foundation.

Bracht, G. H., & Glass, G. V. (1968). The external validity of experiments. *American Educational Research Journal, 5,* 437–474.

Braun, T. M., & Feng, Z. (2001). Optimal permutation tests for the analysis of group randomized trials. *Journal of the American Statistical Association, 96,* 1424–1432.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2,* 141–178.

Byrne, B., & Fielding-Barnsley, R. (1991). Evaluation of a program to teach phonemic awareness to young children. *Journal of Educational Psychology, 83,* 451–455.

Calfee, R. (1992). Refining educational psychology: The case of the missing links. *Educational Psychologist, 27,* 163–175.

Campbell, D. T., & Boruch, R. F. (1975). Making the case for randomized assignment to treatments by considering the alternatives: Six ways in which quasi-experimental evaluations in compensatory education tend to underestimate effects. In C. A. Bennett & A. A. Lumsdaine (Eds.), *Evaluation and experiment: Some critical issues in assessing social programs* (pp. 195–296). New York, NY: Academic Press.

Campbell, D. T., & Stanley, J. C. (1966). *Experimental and quasi-experimental designs for research*. Chicago, IL: Rand-McNally.

Carlson, J. S., & Levin, J. R. (Eds.). (2012). *Instructional strategies for improving students' learning: Focus on early reading and mathematics*. Charlotte, NC: Information Age.

Chambless, D. L., & Ollendick, T. H. (2001). Empirically supported psychological interventions: Controversies and evidence. *Annual Review of Psychology, 52,* 685–716.

Chorpita, B. F. (2007). *Modular cognitive-behavioral therapy for childhood anxiety disorders*. New York, NY: Guilford Press.

Cliff, N. (1983). Some cautions concerning the application of causal modeling methods. *Multivariate Behavioral Research, 18,* 115–126.

Cobb, P., & Bowers, J. (1999). Cognitive and situated learning perspectives in theory and practice. *Educational Researcher, 28*(2), 4–15.

Cole, N. S. (1997). "The vision thing": Educational research and AERA in the 21st century. Part 2: Competing visions for enhancing the impact of educational research. *Educational Researcher, 26*(4), 13, 16–17.

Collins, A. (1992). Toward a design science of education. In E. Scanlon & T. O'Shea (Eds.), *New directions in educational technology* (pp. 15–22). New York, NY: Springer-Verlag.

Collins, A., Joseph, D., & Bielaczyc, K. (2004). "Design research: Theoretical and methodological issues." *Journal of the Instructional Sciences, 13,* 15–42.

COMMIT Research Group (1995). Community intervention trial for smoking cessation (COMMIT). *American Journal of Public Health, 85,* 183–192.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues for field settings*. Chicago, IL: Rand-McNally.

Copeland, W. D. (1991). Microcomputers and teaching actions in the context of historical inquiry. *Journal of Educational Computing Research, 7,* 421–454.

D'Agostino, J. (2005). Measuring learning outcomes: Reliability and validity issues. In G. D. Phye, D. H. Robinson, & J. R. Levin (Eds.), *Experimental methods for evaluating educational interventions* (pp. 113–145). San Diego, CA: Academic Press.

Derry, S., Levin, J. R., Osana, H. P., Jones, M. S., & Peterson, M. (2000). Fostering students' statistical and scientific thinking: Lessons learned from an innovative college course. *American Educational Research Journal, 37,* 747–773.

Deseret News. (1999, March 15). Piano lessons, computer may help math skills. Salt Lake City, UT.

The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5–8.

Deslauriers, L., Schelew, E, & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science, 332,* 862–864.

Donner, A., & Klar, N. (2000). *Design and analysis of cluster randomization trials in health research*. New York, NY: Oxford University Press.

Donmoyer, R. (1993). Yes, but is it research? *Educational Researcher, 22*(3), 41.

Doyle, W., & Carter, K. (1996). Educational psychology and the education of teachers: A reaction. *Educational Psychologist, 31,* 23–28.

Dressman, M. (1999). On the use and misuse of research evidence: Decoding two states' reading initiatives. *Reading Research Quarterly, 34,* 258–285.

Duffy, G. R., Roehler, L. R., Sivan, E., Rackliffe, G., Book, C., Meloth, M. S., . . . Bassiri, D. (1987). Effects of explaining the reasoning associated with using reading strategies *Reading Research Quarterly, 22,* 347–368.

Edgington, E. S., & Onghena, P. (2007). *Randomization tests* (4th ed.). Boca Raton, FL: Chapman & Hall/CRC.

Eisner, E. (1997). The promise and perils of alternative forms of data representation. *Educational Researcher, 26*(6), 4–10.

Eisner, E. (1999). Rejoinder: A response to Tom Knapp. *Educational Researcher, 28*(1), 19–20.

Elashoff, J. D. (1969). Analysis of covariance: A delicate instrument. *American Educational Research Journal, 6,* 381–401.

Finn, J. D., Gerber, S. B., Achilles, C. M., & Boyd-Zaharias, J. (2001). The enduring effects of small classes. *Teachers College Record, 103,* 145–183.

Fuchs, D., Fuchs, L. S., Thompson, A., Al Otaiba, S., Yen, L., Yang, N. J., . . . O'Connor, R. E. (2001). Is reading important in reading-readiness programs? A randomized field trial with teachers as program implementers. *Journal of Educational Psychology, 93,* 251–267.

Fuchs, L. S., Compton, D. L., Fuchs, D., Paulsen, K., Bryant, J. D., & Hamlett, C. L. (2005). The prevention, identification, and cognitive determinants of math difficulty. *Journal of Educational Psychology, 97,* 493–513.

Gast, D. L. (2010). *Single subject research methodology in behavioral sciences*. New York, NY: Routledge.

Goldstein, H. (2003). *Multilevel statistical models* (3rd ed.). London, UK: Edward Arnold.

Goldstein, H. (2011). Ethical aspects of multilevel modeling. In A. T. Panter & S. K. Sterba (Eds.), *Handbook of ethics in quantitative methodology* (pp. 341–355). New York, NY: Routledge.

Goode, E. (1999, March 19). New and old depression drugs are found equal. *New York Times,* A1, A16.

Goodson, B., Wolf, A., Bell, S., Turner, H., & Finney, P. B. (2010). *The effectiveness of a program to accelerate vocabulary development in kindergarten(VOCAB)* (NCEE 2010-4014). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Graesser, A. C., & Hu, X. (2011). Commentary on causal prescriptive statements. *Educational Psychology Review, 23,* 279–285.

Graziano, A. B., Peterson, M., & Shaw, G. L. (1999). Enhanced learning of proportional math through music training and spatial-temporal training. *Neurological Research, 21,* 139–152.

Green, J. L., Camilli, G., & Elmore, P. B. (Eds.). (2006). *Handbook of complementary methods in education research*. Mahwah, NJ: Erlbaum.

Grinder, R. E. (1989). Educational psychology: The master science. In M. C. Wittrock & F. Farley (Eds.). *The future of educational psychology: The challenges and opportunities* (pp. 3–18). Hillsdale, NJ: Erlbaum.

Halpern, D. F. (2003). *Thought and knowledge: An introduction to critical thinking* (4th ed.). Mahwah, NJ: Erlbaum.

Hedges, L. V., & Stock, W. (1983). The effects of class size: An examination of rival hypotheses. *American Educational Research Journal, 20,* 63–85.

Hitt, J. (2001, December 9). Evidence-based medicine. In "The year in ideas," *New York Times Magazine* (Section 6).

Hooper, J. (1999). A new germ theory. *Atlantic Monthly, 283* (2), 41–53.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single subject research to identify evidence-based practice in special education. *Exceptional Children, 71,* 165–179.

Horner, R., & Spaulding, S. (2010). Single-case research designs. In N. J. Salkind (Ed.), *Encyclopedia of research design* (pp. 1386–1394). Thousand Oaks, CA: Sage.

Hsieh, P. -H., Acee, T., Chung, W. -H., Hsieh, Y. -P., Kim, H., Thomas, G. D., . . . Robinson, D. H. (2005). Is educational intervention research on the decline? *Journal of Educational Psychology, 97,* 523–529.

Huitema, B. E. (1980). *The analysis of covariance and alternatives*. New York, NY: Wiley.

Jaeger, R. M. (Ed.). (1988). *Complementary methods for research in education*. Washington, DC: American Educational Research Association.

Jaeger, R. M., & Bond, L. (1996). Quantitative research methods and design. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 877–898). New York, NY: Macmillan.

Jenkins, J. S. (2001). The Mozart effect. *Journal of the Royal Society of Medicine, 94,* 170–172.

Kaestle, C. F. (1993). The awful reputation of education research. *Educational Researcher, 22* (1), 23–31.

Katsnelson, A. (2010). No gain from brain training. *Nature, 464,* 1111.

Kazdin, A. E. (1981). Drawing valid inferences from case studies. *Journal of Consulting and Clinical Psychology, 49,* 183–192.

Kazdin, A. E. (2003). *Research design in clinical psychology* (4th ed.). Upper Saddle, NJ: Pearson.

Kazdin, A. E. (2011). *Single-case research designs: Methods for clinical and applied settings* (2nd ed.). New York. NY: Oxford University Press.

Kelly, A. E. (2004). Design research in education: Yes, but is it methodological? *Journal of the Learning Sciences, 13,* 115–128.

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York, NY: Guilford Press.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York, NY: Guilford Press.

Koehler, M. J., & Levin, J. R. (1998). Regulated randomization: A potentially sharper analytical tool for the multiple-baseline design. *Psychological Methods, 3,* 206–217.

Krathwohl, D. R. (1993). *Methods of educational and social science: An integrated approach*. White Plains, NY: Longman.

Kratochwill, T. R. (1985). Case study research in school psychology. *School Psychology Review, 14,* 204–215.

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (in press). *Remedial and special education*.

Kratochwill, T. R., & Levin, J. R. (Eds.). (1992). *Single-case research design and analysis: New developments for psychology and education*. Hillsdale, NJ: Erlbaum.

Kratochwill, T. R., & Levin, J. R. (2010). Enhancing the scientific credibility of single-case intervention research: Randomization to the rescue. *Psychological Methods, 15,* 122–144.

Kratochwill, T. R., McDonald, L., Levin, J. R., Scalia, P. A., & Coover, G. (2009). Families and schools together: An experimental study of multi-family support groups for children at risk. *Journal of School Psychology, 47,* 245–265.

Kratochwill, T. R., McDonald, L., Levin, J. R., Youngbear-Tibbetts, H., & Demaray, M. K. (2004). Families and schools together: An experimental analysis of a parent-mediated, multi-family group intervention for American Indian children. *Journal of School Psychology, 42,* 359–383.

Kratochwill, T. R., Mott, S. E., & Dodson, C. L. (1984). Case study and single-case research in clinical and applied psychology. In A. S. Bellack & M. Hersen (Eds.), *Research methods in clinical psychology* (pp. 55–99). New York, NY: Pergamon Press.

Kratochwill, T. R., & Shernoff, E. S. (2003). Evidence-based practice: Promoting evidence-based interventions in school psychology. *School Psychology Quarterly, 18,* 389–408.

Kratochwill, T. R., & Stoiber, K. C. (2000). Empirically supported interventions and school psychology: Conceptual and practical issues: Part II. *School Psychology Quarterly, 15,* 233–253.

Kratochwill, T. R., & Stoiber, K. C. (2002). (Eds.). *Procedural and coding manual for review of evidence-based interventions*. Task Force on Evidence-Based Interventions in School Psychology, Division 16 of the American Psychological Association and the Society for the Study of School Psychology. Available from Thomas R. Kratochwill, School Psychology Program, 1025 West Johnson St., University of Wisconsin-Madison, Madison, WI 53706–1796.

Labaree, D. F. (1998). Educational researchers: Living with a lesser form of knowledge. *Educational Researcher, 27* (8), 4–12.

Levin, J. R. (1985). Some methodological and statistical "bugs" in research on children's learning. In M. Pressley & C. J. Brainerd (Eds.), *Cognitive learning and memory in children* (pp. 205–233). New York, NY: Springer-Verlag.

Levin, J. R. (1992). On research in classrooms. *Mid-western educational researcher, 5,* 2–6, 16.

Levin, J. R. (1994). Crafting educational intervention research that's both credible and creditable. *Educational Psychology Review, 6,* 231–243.

Levin, J. R. (1997a). Overcoming feelings of powerlessness in Aging@researchers: A primer on statistical power in analysis of variance designs. *Psychology and Aging, 12,* 84–106.

Levin, J. R. (1997b, March). *Statistics in research and in the real world*. Colloquium presentation, Department of Psychology, University of California, San Diego.

Levin, J. R. (2004). Random thoughts on the (in)credibility of educational-psychological intervention research. *Educational Psychologist, 39,* 173–184.

Levin, J. R. (2005). Randomized classroom trials on trial. In G. D. Phye, D. H. Robinson, & J. R. Levin (Eds.), *Experimental methods* *for evaluating educational interventions* (pp. 3–27). San Diego, CA: Academic Press.

Levin, J. R., Lall, V. F., & Kratochwill, T. R. (2011). Extensions of a versatile randomization test for assessing single-case intervention effects. *Journal of School Psychology, 49,* 55–79.

Levin, J. R., & Levin, M. E. (1993). Methodological problems in research on academic retention programs for at-risk minority college students. *Journal of College Student Development, 34,* 118–124.

Levin, J. R., & O'Donnell, A. M. (1999). What to do about educational research's credibility gaps? *Issues in Education: Contributions from Educational Psychology, 5,* 177–229.

Levin, J. R., & O'Donnell, A. M. (2000). Three more cheers for credible educational research! *Issues in Education: Contributions from Educational Psychology, 6,* 181–185.

Levin, J. R., & Peterson, P. L. (1984). Classroom aptitude-by-treatment interactions: An alternative analysis strategy. *Educational Psychologist, 19,* 43–47.

Levin, J. R., & Pressley, M. (1983). Understanding mnemonic imagery effects: A dozen "obvious" outcomes. In M. L. Fleming & D. W. Hutton (Eds.), *Mental imagery and learning* (pp. 33–51). Englewood Cliffs, NJ: Educational Technology Publications.

Levin, J. R., & Robinson, D. H. (1999). Further reflections on hypothesis testing and editorial policy for primary research journals. *Educational Psychology Review, 11,* 143–155.

Levin, J. R., & Serlin, R. C. (1993, Apr.). *No way to treat a classroom: Alternative units-appropriate statistical strategies*. Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Levin, J. R., & Wampold, B. E. (1999). Generalized single-case randomization tests: Flexible analyses for a variety of situations. *School Psychology Quarterly, 14,* 59–93.

Levin, M. E., Levin, J. R., & Scalia, P. A. (1997). What claims can a comprehensive college program of academic support support? *Equity & Excellence in Education, 30,* 71–89.

Lindquist, E. F. (1940). Sampling in educational research. *Journal of Educational Psychology, 31,* 561–574.

Lipsey, M. W., & Cordray, D. S. (2000). Evaluation methods for social intervention. *Annual Review of Psychology, 51,* 345–375.

Loftus, E. (1998). Who is the cat that curiosity killed? *APS Observer, 11*(9), 3, 27.

Marascuilo, L. A., & Busk, P. L. (1988). Combining statistics for multiple-baseline AB and replicated ABAB designs across subjects. *Behavioral Assessment, 10,* 1–28.

Mark, M. M., & Lenz-Watson, A. L. (2011). Ethics and the conduct of randomized experiments and quasi-experiments in field settings. In A. T. Panter & S. K. Sterba (Eds.), *Handbook of ethics in quantitative methodology* (pp. 185–209). New York, NY: Routledge.

Marley, S. C., & Levin, J. R. (2011). When are prescriptive statements in educational research justified? *Educational Psychology Review, 23,* 197–206.

Mathes, P. G., Denton, C. A., Fletcher, J. M., Anthony, J. L., Francis, D. J., & Schatschneider, C. (2005). The effects of theoretically different instruction and student characteristics on the skills of struggling readers. *Reading Research Quarterly, 40,* 148–182.

Mayer, R. E. (1993). Outmoded conceptions of educational research. *Educational Researcher, 22,* 6.

Mayer, R. E. (2005). The failure of educational research to impact educational practice: Six obstacles to educational reform. In G. D. Phye, D. H. Robinson, & J. R. Levin (Eds.), *Experimental methods for evaluating educational interventions* (pp. 67–81). San Diego, CA: Academic Press.

McDonald, S. -K., Keesler, V. A., Kauffman, N. J., & Schneider, B. (2006). Scaling-up exemplary interventions. *Educational Researcher, 35*(3), 15–24.

McGuire, K. (1999). *1999 request for proposals*. Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Moher, D., Schulz, K. F., & Altman, D. G. (2001). The CONSORT statement: Revised recommendations for improving the quality of reports of parallel-group randomized trials. *Annals of Internal Medicine, 134,* 657–662.

Mosteller, F., & Boruch, R. (Eds.). (2002). *Evidence matters: Randomized trials in education research*. Washington, DC: Brookings Institution Press.

Murnane, R. J., & Willett, J. B. (2011). *Methods matter: Improving causal inference in educational and social science research*. New York, NY: Oxford University Press.

Muthen, B. (1989). Teaching students of educational psychology new sophisticated statistical techniques. In M. C. Wittrock & F. Farley (Eds.). *The future of educational psychology: The challenges and opportunities* (pp. 1818–189). Hillsdale, NJ: Erlbaum.

Nantais, K. M., & Schellenberg, E. G. (1999). The Mozart effect: An artifact of preference. *Psychological Science, 10,* 370–373.

National Education Policy Center. (2011). *About the National Education Policy Center*. Retrieved from http://nepc.colorado.edu/about-us

National Institutes of Health (1989, June 10). *NIH policy for data and safety monitoring*. Bethesda, MD.

Needels, M. C., & Knapp, M. S. (1994). Teaching writing to children who are underserved. *Journal of Educational Psychology, 86,* 339–349.

Nye, B., Hedges, L. V., & Konstantopoulos, S. (2000). The effects of small classes on academic achievement: The results of the Tennessee class size experiment. *American Educational Research Journal, 37,* 123–151.

O'Donnell, A. M., Hmelo-Silver, C., & Erkens, G. (2006). *Collaborative learning, reasoning, and technology*. Mahwah, NJ: Erlbaum.

O'Donnell, A. M., & Levin, J. R. (2001). Educational psychology's healthy growing pains. *Educational Psychologist, 36,* 73–82.

Osana, H. P., & Pitsolantis, N. (in press). Addressing the struggle to link form and understanding in fractions instruction. *British Journal of Educational Psychology*.

Page, E. B. (1965, February). *Recapturing the richness within the classroom*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Pearl, J. (2011). The science and ethics of causal modeling. In A. T. Panter & S. K. Sterba (Eds.), *Handbook of ethics in quantitative methodology* (pp. 383–414). New York, NY: Routledge.

Peckham, P. D., Glass, G. V., & Hopkins, K. D. (1969). The experimental unit in statistical analysis. *Journal of Special Education, 3,* 337–349.

Peterson, A. V. Jr., Mann, S. L., Kealey, K. A., & Marek, P. M. (2000). Experimental design and methods for school-based randomized trials: Experience from the Hutchinson smoking prevention project (HSPP). *Controlled Clinical Trials, 21,* 144–165.

Phye, G. D., Robinson, D. H., & Levin, J. R. (Eds.). (2005). *Experimental methods for evaluating educational interventions*. San Diego, CA: Academic Press.

Platt, J. R. (1964). Strong inference. *Science, 146,* 347–353.

Pressley, M., & Allington, R. (1999). What should reading instructional research be the research of? *Issues in Education: Contributions From Educational Psychology, 5,* 1–35.

Pressley, M., El-Dinary, P. B., Gaskins, I., Schuder, T., Bergman, J. L., Almasi, J., & Brown, R. (1992). Beyond direct explanation: Transactional instruction of reading comprehension strategies. *Elementary School Journal, 92,* 513–555.

Raudenbush, S. W. (2005). Learning from attempts to improve schooling: The contribution of methodological diversity. *Educational Researcher, 34*(5), 25–31.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage.

Raudenbush, S. W., & Liu, X. (2000). Statistical power and optimal design for multisite randomized trials. *Psychological Methods, 5,* 199–213.

Rauscher, F. H., Shaw, G. L., Levine, L. J., Wright, E. L., Dennis, W. R., & Newcomb, R. L. (1997). Music training causes long-term enhancement of preschool children's spatial-temporal reasoning. *Neurological Research, 19,* 2–8.

Reinhart, A., Haring, S., Levin, J. R., Patall, E. A., & Robinson, D. H. (2012). *Models of not-so-good behavior: Yet another way to squeeze causality and recommendations for practice out of correlational data.* Unpublished manuscript, Department of Educational Psychology, University of Texas, Austin.

Reuther, E. T., Davis, T. E. III, Moree, B. N., & Matson, J. L. (2011). Treating selective mutism using modular CBT for child anxiety: A case study. *Journal of Clinical Child & Adolescent Psychology, 40,* 156–163.

Riehl, C. (2006). Feeling better: A comparison of medical research and education research. *Educational Researcher, 35*(5), 24–29.

Robinson, D. H., & Levin, J. R. (2010). The not-so-quiet revolution: Cautionary comments on the rejection of hypothesis testing in favor of a "causal" modeling alternative. *Journal of Modern Applied Statistical Methods, 9,* 332–339.

Robinson, D. H., Levin, J. R., Thomas, G. D., Pituch, K. D., & Vaughn, S. (2007). The incidence of "causal" statements in teaching and learning research journals. *American Educational Research Journal, 44,* 400–413.

Rodgers, J. L. (2010). The epistemology of mathematical and statistical modeling: A quiet methodological revolution. *American Psychologist, 65,* 1–12.

Romberg, T. A. (1992). Perspectives on scholarship and research methods. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 49–64). New York, NY: Macmillan.

Sabelli, N. H., & Kelly, A. E. (1998). The NSF learning and intelligent systems research initiative: Implications for educational research and practice. *Educational Technology, 38*(2), 42–46.

Salomon, G. (1995). Reflections on the field of educational psychology by the outgoing journal editor. *Educational Psychologist, 30,* 105–108.

Salomon, G., & Almog, T. (1998). Educational psychology and technology: A matter of reciprocal relations. *Teachers College Record, 100,* 222–241.

Schochet, P., Cook, T., Deke, J., Imbens, G., Lockwood, J. R., Porter, J., & Smith, J. (2010). *Standards for regression discontinuity designs*. Retrieved from What Works Clearinghouse website: http://ies.ed.gov/ncee/wwc/pdf/wwc_rd.pdf

Scriven, M. (1960). The philosophy of science in educational research. *Review of Educational Research, 30,* 422–429.

Scriven, M. (1997). "The vision thing": Educational research and AERA in the 21st century. Part 1: Competing visions of what educational researchers should do. *Educational Researcher, 26*(4), 19–21.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton Mifflin.

Shadish, W. R., & Rindskopf, D. M. (2007). Methods for evidence-based practice: Quantitative synthesis of single-subject designs. *New Directions for Evaluation,* No. 113, 95–109.

Shavelson, R. J., & Towne, L. (Eds.). (2002). *Scientific research in education*. Washington, DC: National Academy Press.

Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics, 69,* 99–118.

Slavin, R. E. (1997). Design competitions: A proposal for a new federal role in educational research and development. *Educational Researcher, 26*(1), 22–28.

Slavin, R. E. (1999). Yes, control groups are essential in program evaluation: A response to Pogrow. *Educational Researcher, 28*(3), 36–38.

Slavin, R. E. (2002). Evidence-based education policies: Transforming educational practice and research. *Educational Researcher, 31*(7), 15–21.

Slavin, R. E., Madden, N. A., Dolan, L. J., & Wasik, B. A. (1996). *Every child, every school: Success for All*. Thousand Oaks, CA: Corwin.

Sroufe, G. E. (1997). Improving the "awful reputation" of education research. *Educational Researcher, 26*(7), 26–28.

Stanovich, K. E. (1999). Educational research at a choice point. *Issues in Education: Contributions from Educational Psychology, 5,* 267–272.

Stanovich, K. E. (2007). *How to think straight about psychology* (8th ed.). New York, NY: Allyn & Bacon/Longman.

Stanovich, P. J., & Stanovich, K. E. (2003). *Using research and reason in education: How teachers can use scientifically based research to make curricular & instructional decisions*. Portsmouth, NH: RMC Research Corp. http://lincs.ed.gov/publications/pdf/Stanovich_Color.pdf

Steele, K. M., Bass, K. E., & Crook, M. D. (1999). The mystery of the Mozart effect: Failure to replicate. *Psychological Science, 10,* 366–369.

Stevens, R. J., Slavin, R. E., & Farnish, A. M. (1991). The effects of cooperative learning and direct instruction in reading comprehension strategies on main idea identification. *Journal of Educational Psychology, 83,* 8–16.

Stein, J. (2010, April 7). Study finds glucosamine similar to placebo. *Seattle Times,* A5.

Suter, L. (1999, April). *Research methods in mathematics and science research: A report of a workshop*. Symposium presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Thu, K. M. (1999). Anthropologists should return to the roots of their discipline. *Chronicle of Higher Education, 45*(34), A56.

Torgesen, J. K., Morgan, S. T., & Davis, C. (1992). Effects of two types of phonological awareness training on word learning in kindergarten children. *Journal of Educational Psychology, 84,* 364–370.

Townsend, A. R., Hicks, L., Thompson, J. D. M., Wilton, K. M., Tuck, B. F. & Moore, D. W. (1993). Effects of introductions and conclusions in assessment of student essays. *Journal of Educational Psychology, 85,* 670–678.

Uchitelle, L. (1999, April 20). A real-world economist: Krueger and the empiricists challenge the theorists. *New York Times,* C1, C10.

U.S. Department of Education. (1986). *What works*. Washington, DC: Author.

U.S. Government Accounting Office. (1997). *Head Start: Research provides little information on impact of current program*. Washington, DC: Author.

Walberg, H. J., & Welch, W. W. (1972). A national experiment in curriculum evaluation. *American Educational Research Journal, 9,* 373–384.

Walker, V. S. (1999, April). [Speaker]. *Research training in education: What are the essentials and can we agree?* (Cassette Recording No: 2.39). Washington, DC: American Educational Research Association.

Wampold, B. E., Mondin, G. W., Moody, M., Stich, F., Benson, K., & Ahn, H. (1997). A meta-analysis of outcome studies comparing bona fide psychotherapies: Empirically, "All must have prizes." *Psychological Bulletin, 122,* 203–215.

Wampold, B. E., & Worsham, N. L. (1986). Randomization tests for multiple-baseline designs. *Behavioral Assessment, 8,* 135–143.

Weisz, J. R., & Hawley, K. (2001, June). *Procedural and coding manual for identification of beneficial treatments*. Draft document of the Committee on Science and Practice Society for Clinical Psychology, Division 12, American Psychological Association.

What Works Clearinghouse. (2008). *Procedures and standards handbook* (Version 2.0). Retrieved from http://ies.ed.gov/ncee/wwc/pdf/wwc_version1_standards.pdf

Whitehurst, G. J. (2003, April). *The Institute of Education Sciences: New wine, new bottles*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Whitehurst, G. J., Epstein, J. N., Angell, A. L., Payne, A. C., Crone, D. A., & Fischel, J. E. (1994). Outcomes of an emergent literacy intervention in Head Start. *Journal of Educational Psychology, 86,* 542–555.

Wilkinson, L., and the Task Force on Statistical Inference. (1999). Statistical methods in psychology journals: Guidelines and explanations. *American Psychologist, 54,* 594–604.

Winner, E., & Hetland, L. (1999, March 4). Mozart and the S.A.T.'s. *New York Times,* A25.

Wittrock, M. C. (1994). An empowering conception of educational psychology. *Educational Psychologist, 27,* 129–141.

Wong, L. Y. -S. (1995). Research on teaching: Process-product research findings and the feeling of obviousness. *Journal of Educational Psychology, 87,* 504–511.

CHAPTER 20

Educational Psychology and Educational Transformation

BARBARA L. McCOMBS

INTRODUCTION

In tackling the update of my chapter in the first edition of this *Handbook*, I am struck by how much has changed in our nation and world since the first edition was published in 2003. These changes have obviously affected the work of educational psychologists in general. They have also dramatically affected the work of those writing chapters for this edition. The field is changing and so are research findings, methods, and approaches to studying issues important to educational transformation on both a national and global scale.

My purposes in this chapter are multifold. First, I lay out what I see as the most important emerging trends and those that have already taken shape in the field of educational psychology. Second, I highlight what are the major changes in each section of this chapter as they relate to the current work being done in related fields that are topics of this handbook. Third, I pull together emerging principles from an integrated look at the research in diverse fields as a way to encourage both new and current researchers to engage in the types of collaborative efforts with new research models and methods—many of which are already being conducted at national levels and to some extent at global levels. Finally, I conclude with what I see as next steps for research, practice, and policy with a focus on new learning technologies and professional development models to which educational psychology can make some of its most important contributions to educational transformation in this 21st century.

The Continuing Contributions of Research on Effective Reform

As with the first edition, I continue to be struck by the impressive collection of work by colleagues in the field of educational psychology and how important these contributions are to effective educational reform. In addition, I am now impressed with the synergy emerging in the field and how the research by educational psychologists is moving toward new understandings that can actually transform our current, outdated, and openly acknowledged industrial model into the kind of teaching and learning system needed in our current information age.

The challenges we face today in applying what we have learned—challenges that span making our work more visible, accessible, and credible to educators, policymakers, and the public—continue to plague researchers to an even greater degree in some cases that I highlight in this chapter. My focus is on how educational psychology's knowledge base can best be applied to rapidly changing 21st-century educational reform issues and, in so doing, discuss what policy implications arise.

As with the earlier version of this chapter, I address this topic in five parts: (1) what we have learned, (2) how work in educational psychology has contributed to effective reform, (3) what research directions are still needed, (4) how our knowledge base can best address issues of concern in the current reform agenda, and (5) what policy issues must be addressed in 21st-century educational reform efforts. Prior to beginning these topics, however, I would like to clarify once again what I understand to be the purpose and function of educational psychology as a credible knowledge base and science.

How Educational Psychology Has and Is Being Defined

The definitions of educational psychology have been varied over more than a century of psychological research on learning, but one commonality exists: There is widespread agreement that educational psychology is by definition an applied science. What that means to me is that it functions to conduct "applications-driven" research, development, and evaluation in the areas of human motivation, learning, development, and individual differences. This is research that creates knowledge that informs practice and can be applied to the teaching and learning process in school settings in ways that enhance human potential and performance. The accumulated knowledge base also has led to principles, axioms, and theorems that are now surfacing and that are beginning to inform more holistic approaches for transforming education and the research we do in the diverse fields that comprise the core of educational psychology.

Applications of educational psychology's knowledge base must of necessity acknowledge the complexities of individuals and the educational systems and structures within which they operate throughout kindergarten to adult school settings. Systemic, inter- and multidisciplinary attention to how what we have learned about teaching and learning from diverse areas of research—including cognitive, motivational, social, and developmental—must be integrated with applications in schooling areas that include curriculum, instruction, assessment, teacher development, and school management, to name a few. Those of us working in this arena must, therefore, understand the context of schools as living systems—systems that operate at personal, technical, and organizational levels and that support personal, organizational, and community levels of learning. This places a responsibility on those working in the field of educational psychology to have both a breadth and depth of knowledge—not only about teaching and learning at the individual or process levels, but also about how this knowledge can be comprehensively integrated for application in diverse school settings and systems.

This has been true for decades and recognized by some in our profession but mostly by those concerned with progressive education that focuses on the whole child or whole learner. In spite of the fact that when the American Psychological Association was formed and the first Division was Educational Psychology, the decades since have seen more specialization and separation of disciplines. The pendulum is now swinging the other way from my perspective and I discuss that in the sections that follow. For now, it is important to understand that given its applied nature and broad function, educational psychology also has to satisfy the tension between scientifically defensible research and research that has ecological validity in pre-K-20 school settings and into lifelong learning and adult learning disciplines. This tension has been with the field since the beginning and we have learned much in over a century of research. One of our biggest challenges will be to educate others about what we have learned and, in the process, help them recognize our current and future roles in 21st-century educational transformation efforts.

WHAT HAVE WE LEARNED ABOUT LEARNING, TEACHING, COGNITION, MOTIVATION, DEVELOPMENT, AND INDIVIDUAL DIFFERENCES?

To establish a context for discussing what we have learned that is applicable to educational transformation issues and that have arisen in the past decade, this section begins with a brief review of major educational reform initiatives occurring nationally and internationally in the areas of assessment, standards, and accountability. These topics are chosen because the past decade has seen an increased focus in the United States on these issues, while in many places in Europe and around the world the focus has been *away* from these issues. That in itself is an interesting statement about the directions our country is taking—directions that are increasingly *not advocated* by research by educational psychologists (cf., R. Caine & Caine, 2011; Fullan, 2010; Lee, 2011; McCombs & Miller, 2007, 2009; Penuel & Riel, 2007; Sternberg, 2011; Wentzel & Wigfield, 2009).

As with all research, what I am reviewing begins with my perceptions of how educational psychology has been involved in reform movements and how the growing knowledge base can address reform issues in the 21st century. In the previous edition, I provided an example of a comprehensive project to define and disseminate the psychological knowledge base on learning, motivation, and development provided. This example involves the work of the APA Task Force on Psychology in Education, notably their development and dissemination of the *Learner-Centered Psychological Principles* (APA, 1993, 1997) as a set of guidelines and a framework for school redesign and reform. Since then, however, many others in our field have (both nationally and internationally) advanced their own set of learning principles, or axioms, that have moved the field further in the direction of providing solid research evidence for educational reform and transformation (cf., R. Caine & Caine, 2011; Sternberg, 2011).

DEFINING EDUCATIONAL REFORM, TRANSFORMATION, AND THE STATUS OF 21ST-CENTURY REFORM EFFORTS

For the past several decades, education reform has been a topic in the forefront of educators, researchers, policymakers, and the public since the 1983 *Nation at Risk* report. From the 1990s into this 21st century, reform efforts have focused on a number of issues including state and national academic standards, standardized state and national testing, and increased accountability for schools and teachers. The overall goal of all these efforts has been to create better schools in which more students learn to higher levels (Fuhrman & Odden, 2001). In the process of moving toward this goal, there has been increased recognition that improvements are needed in instruction and professional development, and that transformed practices rather than more of the old methods are needed. A current focus on high stakes testing has produced results in some schools, but clearly not in all. In fact, recent data suggest that this focus has *hurt* student achievement, contributed to increased student alienation and dropout, and increased behavioral problems such as bullying and youth suicide (e.g., Archambault, Eccles, & Vida, 2010; Buziak & Laitusis, 2010; Duchesne & Ratelle, 2010; Efklides, 2011; Huang, 2010; Green, Torney-Purta, & Azevedo, 2010; Gregory et al., 2010; Morris & Hiebert, 2011; Shaw, Walls, Dacy, Levin, & Robinson, 2010; Wai, Lubinski, Benbow, & Steiger, 2010).

Sensing the Urgency of the Need to Reform and Transform

There continues to be an even faster and more urgent recognition that many practices need to be dramatically changed to reflect current knowledge about learning, motivation, and development. Educators and researchers are increasingly speaking in one voice and arguing for a number of similar yet diverse research-validated frameworks to guide systemic reform efforts. Contributors to this volume are presenting even more persuasive and credible findings from educational psychology as a foundation for these emerging frameworks. As we see, the research is beginning to converge on the need for more collaborative, multimethod, and holistic models that address the whole learner—including students and educators alike. The role of family and community in supporting schools and responding to local contexts and cultures are emerging themes across many of these research efforts. In fact, in the United Kingdom a new journal was recently announced as new to Routledge in 2011, the *Journal of Trust Research* that can be accessed at www.tandf.co.uk/journals/RJTR. As stated in the announcement for this journal:

> Trust is imperative to constructive social interaction and cooperation at and across all levels. Positioned as a high-impact source journal providing novel ideas for other journals (both academic and practical), the mission of **JTR** is:
>
> - to **inquire** into the nature, form, base and role of trust as well as the mechanism and stage of trust-building and trust repair at and across personal, group, organizational, community and national levels so as to facilitate and stimulate informed academic dialogue and debate toward an integrative body of knowledge via both relevant and rigorous theory-building and theory-testing
> - to **influence** individuals, groups, organizations, communities and nations in the choice of practical solutions for their trust-related management by providing the most relevant and rigorous research.

What is also of note is the philosophy of this journal in that it reflects the emerging interest in inter-disciplinary, cross-cultural, cross-level, multimethod, context-rich, process-oriented, and practice-relevant studies. This philosophy as found in the earlier web link emphasizes that they are interested in perspectives that effectively investigate the holistic content and dynamic process of organizational and societal trust. *The Journal of Trust Research* (JTR) wants to avoid the perils of reductionist assumptions and are seeking manuscripts that reflect emerging trends that can contribute to a rich and deep understanding of the complex phenomenon of trust.

So What Has Changed in the Past Decade of Research?

In my earlier chapter I noted that the field as discussed by Marx (2000) was beginning to formulate links between school reform and research in educational psychology. At that time, our field was making considerable progress in providing new conceptions, principles, and models to guide thinking about reforms that match what we know about learning, motivation, individual differences, and development. A decade ago unto the present, applying what we know to existing schools is not a simple matter. But considerable progress is being made by researchers who have learned to navigate through political and social issues and attend to the best of what we know concerning the reciprocity of learning and change from a psychological perspective.

To provide an example, my earlier chapter presented the Goertz (2001) argument that for effective reform we will need ways to balance compliance and flexibility in implementing standards-based reform that is sensitive to federal, state, and local contexts and needs. It also stressed that we will need ways to ensure that substantial learning opportunities are provided for all learners in the system—including teachers, school leaders, students, and parents (Cohen & Ball, 2001). It called for new policies as well as increased resources for capacity building if performance-based accountability practices are to be successful (Elmore & Fuhrman, 2001), as well as ways to bridge the divide between secondary and postsecondary education (Kirst & Venezia, 2001). I included Wassermann's (2001) contention that the debate about the use of standardized tests to drive teaching must be balanced with collaborative efforts to define what is important to us in the education of our youth. I mentioned that others are arguing for the increased use of assessment data to guide reform efforts, the need to attend to cultural changes, and the importance of strengthening the role of effective leadership and support for reform efforts (Corcoran, Fuhrman, & Belcher, 2001). To further round out the systemic nature of these issues, Odden (2001) was cited as arguing that new school finance models are needed to incorporate cost findings into school finance structures such that adequate fiscal resources are available to districts and schools for effective programs. I made a final conclusion that these challenges must be met in an era of increased localization of funding.

Now a decade later, all these issues are still in the forefront and the field is increasingly identifying them and finding solutions. The next sections put forth what I see as the most hopeful and promising research for our field.

The Role of Educational Psychology in Reform Efforts

The past more than a century of research on learning has journeyed through a variety of theories that have alternately focused on behavioral, emotional, and/or cognitive aspects of learning. More recently, however, neuroscientists have joined with social scientists and others to explore recent findings from brain research that can extend and complement findings in our fields (as well as related social science fields). This range of perspectives and the ways in which knowledge derived from these theories has been applied to school and classroom practices has had, at best, a checkered history of successes and failures. For many educators, "research-based" has become a dirty word—a word that connotes something that is here today and gone tomorrow when the next research fad appears. In the past decade or two, the picture increasingly appears to be changing with current researchers in educational psychology looking at learning from a more integrative, collaborative, and transdisciplinary perspective. Even of more interest to me and others in our field is that our social science research is increasingly accepted by hard science researchers in fields such as physics, astronomy, and applied fields such as engineering and computer science (e.g., Dede, 2009; Penuel & Riel, 2007; Pink, 2009; Wheatley, 2010).

The Need for a Learner- and Learning-Centered Contextualized Approach

I believe the solutions we must offer have to start at the core with an understanding of individual learners and what we know about learning. That is the only reasonable approach when one is dealing with a rapidly changing landscape that is likely to accelerate in days and years to come. In addition, the educational system must be viewed as organic and living in service to the natural learning of people—students, teachers, administrators, and parents alike. It must be grounded on a core belief in the inherent tendency of all people to learn for a lifetime. Further, it must start with a value all can embrace: *Schooling and education are the fundamental means to develop each learner's unique potential to contribute to a global world in a way that is meaningful and relevant to him or her.* Any other basic value will have the consequence we have already seen in the current system. Too many dropouts, too many disengaged students, too many students who simply comply with more shallow learning and testing to "get through," too many students who are depressed and lack the self-confidence to be successful, and too many students who believe they can learn more of what they need in life outside of school.

This integrative and values-driven focus, shared by many authors in this second edition volume, is based on a growing recognition from various perspectives (e.g., neurological brain research, psychological and sociological research, organizational research, engineering/computer science/mathematics research) that meaningful, sustained learning is a whole person phenomenon. Brain researchers continue to show that even young children have the capacity for complex thinking (e.g., R. Caine & Caine, 2008, 1994, 2011; Chamberlin, 2011; Diamond & Hopson, 1998; Jensen, 1998; McCombs, 2009; Novotney, 2011; Sylwester, 1995). Brain research also shows that affect and cognition work synergistically, with emotion driving attention, learning, memory, and other important mental activities. Research evidence exists on the inseparability of intellect and emotion in learning (e.g., Becker, McElvany, & Kortenbruck, 2010; Elias, Zins et al., 1997; Lazarus, 2000; Lee & Shute, 2010; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010; Radel, Sarrazin, Legrain, & Wild, 2010) and the importance of emotional intelligence to human functioning and health (e.g., Kristjansson, 2010; Lazarus, 2003; Seligman & Csikszentmihalyi, 2003). For example, brain research related to emotional intelligence, reported by Goleman (1995; Goleman, Boyatzis, & McKee, 2002), confirms that humans have an emotional as well as an intellectual (or analytical) brain, both of which are in constant communication and involved in learning, motivation, leadership, and well-being.

Understanding the Social and Relational Nature of Natural Learning

Recent research highlighted by many of the chapters in this volume is also continuing to reveal the social nature of learning along with sociocultural and other contextual factors. Progress in the past decade has included numerous research articles by members of the educational psychology community. Notable among this research is that of Lee and Shute (2010) who explored personal and sociocontextual factors affecting the performance of K–12 students. Their extensive literature review and categorization of variables into student engagement, learning strategies, school climate, and social-familial influences led to further categorization as personal and sociocontextual factors. The resulting integrative framework stresses the importance of personal factors (behavior, affect, attitude, and cognition) as well as their sociocontextual environment as predictors working together to create optimal school performance, particularly in the areas of reading and mathematics. Social and emotional skills are essential for the successful development of cognitive thinking and learning skills. In addition to understanding the emotional and social aspects of learning, research is also confirming that learning is a natural process, inherent to living organisms (APA, 1997; R. Caine & G. Caine, 2011).

From my research and that of others who have explored differences in what learning looks like in and outside of school settings, several things become obvious (e.g., McCombs, 2009; McCombs & Miller, 2007, 2009; Zimmerman & Schunk, 2001). Real-life learning is often playful, recursive, and nonlinear, engaging, self-directed, and meaningful from the learner's perspective. But why are the natural processes of motivation and learning seen in real life rarely seen in most school settings? Research increasingly shows that self-motivated learning is only possible in contexts that provide for choice and control (see Ackerman, 2010; Deakin-Crick, McCombs, Haddon, Broadfoot, & Tew, 2007; Greene & Azevedo, 2010; Jukes, McCain, & Crockett, 2011; Patall, Cooper, & Wynn, 2010). When students have choice and are allowed to control major aspects of their learning (such as what topics to pursue, how and when to study, the emerging learning technologies they want to use, and the outcomes they want to achieve), they are more likely to achieve self-regulation of thinking and learning processes (McCombs, in press b).

One of the most integrative works currently available that advocates both research-validated principles and an integration of neuroscience, psychology, and other related social science fields is the book by Renate and Geoffrey Caine (2011). To paraphrase the summary for this book, it calls our attention to the fact that children are being educated in the world of the classroom and the world of technology. How video games are designed is contrasted with the ways people learn with technology and from real life, and with the way students are taught in school, demonstrating the ways in which traditional education is both limited and inadequate. This is followed by a clarification of how people learn naturally by a synthesis of research from neuroscience, cognitive psychology, biology and education. At the heart of natural learning, the Caines posit that the interplay between perception and action is the dynamic by which students can access their optimal state of mind. Educators and researchers alike need to know about the biological predispositions that come into play in every setting and that allow students and their teachers to understand the individual and social nature of learning.

Of particular importance from the perspective of an educational psychologist interested in applying the latest research findings and methodologies to transform our outdated traditional educational system at all levels is how R. Caine and G. Caine (2011) clarify the practical implications of a natural learning model. Very simply, they argue that for learners to develop into experts in individual areas of potential talent and interest, they must connect what the already know to life itself. For practice, that means that the learner and not the teacher must learn to take control and be guided by their choices of what they want and need to understand, relate to, connect with, or figure out. The teacher is the guide and mentor that challenges, inspires, and supports learning as it is happening in context.

The Need for Ecological Approaches and Emergent Systems Views

Ecologically sound educational models are thus needed to reconnect learners with others and with learning—holistic, person-centered models that also offer challenging 21st century and beyond learning experiences. Many are more urgently arguing that school learning experiences should prepare learners to be knowledge producers, knowledge users, and socially responsible citizens. I ask the question again that I posed 10 years ago: “Of course, we want students to learn socially valued academic knowledge and skills, but is that sufficient?”

My answer then and my answer today is the same: “In the 21st century world, content is so abundant as to make it a poor foundation for basing an educational system; rather, context and meaning are the scare commodities today. This alters the purpose of education to that of helping learners communicate with others, find relevant and accurate information for the task at hand, and be co-learners with teachers and peers in diverse settings that go beyond school walls.” The only thing I would add is that it is more urgent than ever that we grasp the opportunity that is here and still emerging. This opportunity is poised to transform our current paradigm of teaching and learning, educational systems, and leadership development —plus our ways of researching and understanding these interconnected ecological systems (McCombs, in press a).

Some of what I suggested would help us move toward this vision a decade ago still holds. Much has changed more quickly than any of us might have imagined. What still holds is that progress toward this vision will require (1) new concepts defining the learning process and evolving purpose of education and (2) rethinking current directions and practices. The issue a decade ago was how to maintain high standards in learning for desired content and skills, along with along with similar standards for the learner, the learning process, and the learning environment. These parameters and essential components must not be neglected if we are to adequately prepare students for productive and healthy futures that are increasingly unpredictable and uncertain. State and national standards, however, must be critically reevaluated in terms of what is necessary to prepare students to be knowledgeable, responsible, and caring citizens.

RETHINKING WHAT KIND OF STANDARDS WE NEED IN REFORM AND TRANSFORMATION EFFORTS

Standards must move beyond knowledge conservation and reproduction to knowledge creation and production (Hannafin, 1999) as well as express those human qualities that make creation and innovation possible: natural curiosity, learning, and motivation to learn (McCombs & Miller, 2007, 2009). The current focus on content must be balanced with a focus on individual learners and their holistic learning needs in an increasingly complex and fast changing world. Berry (2011) points out that in the past 15 years research has demonstrated that teachers in even the schools with the highest need can make a difference in whether students learn to current standards set at the state and federal levels. Research has also shown, however, that in low-income schools with students of color, these students are more likely to be taught by less-effective and -experienced teachers. Even more recently, Berry cites research showing a “values added” statistical method can provide more precise identification of effective teachers, that is, those who show greater standardized test score gains than teacher peers who teach similar students. Berry further argues that this is not really new research findings—but that these findings continue to be ignored by politicians and policymakers. He argues that it is simply a function of more policy and media hype that ignore today's classroom reality and are based on 20th-century tools and 19th-century principles of teaching and learning.

Berry (2011) more recently has pointed out that teachers (a) are more skilled in the science and art of teaching than ever before, (b) embrace their roles as leaders of school improvements, and (c) increasingly are using their strong collective voices to ensure the their students' needs are adaptively met. He further outlines four emergent realities important for our field (pp. 30–33): (1) teachers and students will experience a transformed learning ecology with digital tools for an array of choices, with instant and accessible information that will lead to new forms of communication and self-expression; (2) cyberspace will provide seamless connections that can be woven in and out, expanding student learning opportunities beyond geographical limits and making schools less dependent on local pedagogical and content expertise; (3) differentiated professional pathways and careers will be available for teachers and teacher leaders to be hybrid-role teachers and change agents who work closely with students as learning partners; and (4) teachers will become innovators and "teacherpreneurs" as an adaptive profession that rewards and empowers its members to find creative solutions to the complex issues and challenges they and their students face. When these emerging trends are realized, Berry believes "Teaching finally will secure the respect it deserves when teacher unions are transformed into professional guilds focusing first and foremost on teaching and learning and expecting all members to meet performance standards" (p. 33). The issue for our field is to see what these performance standards need to be that are not tied to outdated, old century thinking and can help students and teachers share the responsibility for both teaching and learning.

Leading the field as a researcher who has long integrated the best learning principles into the design of emerging technology-supported learning system, Dede (2009) foresaw the Web 2.0 trends that would change the learning and research landscape for years to come. Web 2.0 tools can be customized for research and provide virtual settings for collaboration among stakeholders from many diverse communities and perspectives and levels of expertise. The tools can provide enhanced ways for sharing, thinking, and co-creating as learning partners using their collective wisdom and "an opportunity to experiment with a superset of scholarly norms that provide leverage on wicked problems" (p. 263). If schools do not keep up with this new digital generation of school aged children, Rosen (2011) suggests that kids will pass teacher's by in their learning and understanding of their world through advanced and emerging technologies that immerse them 24/7 in the tech world at all personal and group levels—levels that follow students' natural curiosity and love of learning.

As with each successive generation, the needs of learners are also changing and an issue of growing concern given its relationships to problems such as school dropout is that of youth alienation—and emerging issues such as youth depression, hostility, and brutality toward peers and educators (e.g., Ceci & Papierno, 2005; Chamberlin, 2011; Duchesne & Ratelle, 2010; Gregory, Cornell, Fan, Sheras, Shih, & Huang, 2010; Klein & Cornell, 2010; Swanson, 2004). More than a decade ago, Ryan and Deci (2000) maintained that alienation in any age population is caused by failing to provide supports for competence, autonomy, and relatedness. Meeting these needs are also essential to healthy development and creating contexts that engender individual commitment, effort, and high-quality performance. Unfortunately, there are too many examples in the current educational reform agenda of coercive and punitive consequences for students, teachers, and administrators when students fail to achieve educational standards on state and national tests. The attention by educational psychologists to these issues is obvious in several of the chapters in this volume and the following recent research on the needs of today's learners.

Recent research confirms that for many of today's youth, there is a lack of motivation toward academic activities (e.g., Swanson, 2004). Legault, Green-Demers, and Pelletier (2006) have described this as a motivation (the absence of motivation). This class of behaviors can be attributed to (1) low beliefs in one's ability to be successful, (2) beliefs that the activity is not worth the effort or energy required, (3) the value students place on a task in terms of importance or relevance to the student, and (4) features of the task that are perceived as boring or tedious. Given the prominence of this problem, Legault et al. (2006) argue that academic attitudes and behaviors are strongly influenced by the social context of schools and particularly by the perceived support for autonomy, competence, and relatedness. In a series of studies, these authors looked at the different conditions that give rise to academic motivation. All four conditions were verified, further confirming that if students believe they are neither smart nor capable of exerting effort, they are the most detached from school. Most important was teacher support of student competence by providing students with information and feedback about their academic abilities.

What We Know About Our Youth

Youth are also becoming increasingly competent and knowledgeable about technology in all its various forms. Middle school students are flocking to the web by the millions to build networks beyond classroom walls and to form communities around their passions and talents (Richardson, 2006; Wallis & Steptoe, 2006). They are displaying a range of creative and problem-solving skills in their use of technology tools. Clem and Simpson (2007) report that today's digital learners are different in many ways that require teachers and other educators working with these students to design new kinds of lessons that engage students with new technologies, including simulation style games. Some of the important differences in digital learners include:

- They are proactive, autonomous learners who seek needed information from the environment to meet their own self-determined goals.
- They process information very quickly, deciding almost immediately whether or not something is relevant and useful.
- They relate first to graphics, then to text.
- They solve complex problems in collaborative learning groups.
- They are active participants in their own learning, doing first and asking questions later; they are undeterred by failure and see it as a necessary learning experience that simply leads to a "restart."

We can see the power of creative capacity in students' responses to technology. Technology is clearly a tool of innovation that is underutilized and inequitably distributed in public schools. Most educators and many parents are aware of the gap between students' use and understanding of the latest digital technologies and how these technologies are used/not used in the schools. Prensky (2006) contends that schools are stuck in the 20th century while students have rushed into the 21st century. Today's students were born into the digital age and are fluent in the digital language of computers, video games, and the Internet. Many even report learning to read from games rather than from teachers and school. Because students are empowered by technology in so many ways outside their schools, more than ever they need a meaningful voice in their own digital-age education (McCombs & Vakili, 2005).

Some in our field (Winne, 2010, in particular) have recognized a critical error in research on self-regulated learning (SRL). We have proposed complex models of various categories of characteristics, beginning with student perceptions, which can account for a majority of the variance as to whether students will be self-regulated learners and hence perform at optimal levels. What Winne sees that is a vital shift in our understanding of human learning, is that self-regulation might occur naturally as a fundamental human evolutionary developmental path that begins with simple rules, like choosing a path of least resistance. As development proceeds, learners begin to develop a habitual or dispositional set of tendencies to follow their natural path of interests and curiosities—but in our school environments this is not the accepted way. Winne concludes his insightful analysis of how the field is now shifting its focus in understanding what SRL is all about and is now seeing this phenomenon as *contextual*—meaning it is highly dependent on students using a rapid mix (traces) of cognitive and metacognitive (and no doubt emotional, motivational, and behavioral correlates they choose to bring into play) processes for measuring and analyzing information that is important to them in some way as they learn. For the field this means a big shift—a shift yet to be fully explored or realized but a worthy goal that will more personally and reciprocally involve learners as partners with teachers and researchers in understanding the human learning cycle.

THE NEED FOR HOLISTIC MODELS THAT TRANSFORM THE CURRENT EDUCATIONAL PARADIGM

Educational psychology's growing knowledge base supports comprehensive and holistic educational models. A current challenge is to find these models and link their successful practices to what has been demonstrated relative to the needs of learners in research on learning, motivation, and development. The stories of teachers and other educators must also become part of our credible evidence. In my chapter from a decade ago, I gave the example of Kohl, founder of the Open School Movement, who shared his 36-year experience as a teacher working in dysfunctional, poverty-ridden urban school districts (in Scherer, 1998). He emphasized the importance of teachers projecting hope—convincing students of their worth and ability to achieve in a difficult world. Kohl advocates "personalized learning" based on caring relationship and respect for the unique way each student perceives the world and learns. Respecting students, honoring their perspectives, and providing quality learning are all ways that have been validated in research from educational psychology and related fields. Research from a multitude of studies and contexts has demonstrated the efficacy of these strategies for engaging students in learning communities that encourage invention, creativity, and imagination.

A current example is provided by some senior researchers in our field who have spent their time studying the role of hope—particularly right now when that emotion is sorely needed by educators, students, and the community as a whole. Lopez (2010) makes a research-based case that hope (a) is not significantly related to basic intelligence or income; (b) is consistently linked to attendance, credits earned, and academic achievement; (c) has been shown for middle school students to lead to better grades in core subjects and higher achievement test scores; (d) has been shown for high school and beginning college students to contribute to higher grade point averages; and (e) maintain its predictive power when controlling for intelligence, prior grades, self-esteem, and college entrances exam scores such at the SAT or GRE.

According to Buffum, Mattos, and Weber (2010), we are asking the wrong questions when it comes to trying to change our public educational system. The important questions are not those that related to raising test scores, implementing RTI, staying legal, or trying to figure out what is wrong with students who do not want to learn. The right questions according to Buffum et al. (2010) are those that address the fundamental purpose of *our* school, the knowledge and skills *our* students and *our* children will need to be successful adults, and what *we must* do to ensure that learning is a reality for every individual learner. A three-tiered approach is recommended wherein each successive tier undergoes a systemic transformation, following research validated principles and practices that conform to emerging and current standards of quality research. These three tiers are contextualized at the school, classroom and community levels—encompassing those stakeholder views that are vital to success at local school levels.

The days of the gold standard of randomized clinical trials are numbered—or at least numbered as a sole methodology for social science research as researchers are increasingly engaged in the real world of schools and classrooms. Clay (2010) contends that we are in an emerging and changing era of embracing other methodologies—combining quantitative and qualitative studies, analyzing data from multiple system levels, and involving diverse groups of collaborators, including the participants themselves, in real world problem solving.

Next, I consider what we know that can lead to a principles-driven way forward in both research and practice. My own work is highlighted as an example of how research-validated principles can guide reform and transformation of current outdated and dangerous educational practices. There are, of course, others who have posited similar principles and these folks are acknowledged for their efforts. What I believe sets the following work by the American Psychological Association apart from work by others in our own and related fields is that they have the endorsement of a professional organization that is itself moving beyond its current more fragmented divisional structure to cross disciplinary boundaries that can only benefit all of us.

The Learner-Centered Psychological Principles (LCPs)

In keeping with an awareness of these trends, proactive efforts have been made in the past decade to make educational psychology's knowledge base more visible and accessible to educators and policymakers. One such example is the work of the American Psychological Association (APA). Beginning in 1990, the APA appointed a special Task Force on Psychology in Education, one of whose purposes was to integrate research and theory from psychology and education in order to surface general principles that have stood the test of time and can provide a framework for school redesign and reform. The result was a document that originally specified twelve fundamental principles about learners and learning that, taken together, provide an integrated perspective on factors influencing learning for *all* learners (APA, 1993). This document was revised in 1997 (APA, 1997) and now includes 14 principles that are essentially the same as the original 12 principles except that attention is now given to principles dealing with learning and diversity and with standards and assessment.

The 14 LCPs were developed based on current theories of learning, including constructivism and social constructivism (APA, 1993, 1997). As such, they recognize that individual learners construct their own personally meaningful, goal-directed understanding of any content or experience to be learned. Each individual constructs meaning and understanding based on prior experiences, knowledge, and a host of other personal "filters." Although the social context and the knowledge imparted

TABLE 20.1 The Learner-Centered Psychological Principles

Cognitive and Metacognitive Factors	
Principle 1: Nature of the learning process.	The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.
Principle 2: Goals of the learning process.	The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.
Principle 3: Construction of knowledge.	The successful learner can link new information with existing knowledge in meaningful ways.
Principle 4: Strategic thinking	The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.
Principle 5: Thinking about thinking	Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.
Principle 6: Context of learning	Learning is influenced by environmental factors, including culture, technology, and instructional practices.
Motivational and Affective Factors	
Principle 7: Motivational and emotional influences on learning	What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking.
Principle 8: Intrinsic motivation to learn	The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.
Principle 9: Effects of motivation on effort	Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.
Developmental and Social Factors	
Principle 10: Developmental influence on learning	As individuals develop, they encounter different opportunities and experience different constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.
Principle 11: Social influences on learning	Learning is influenced by social interactions, interpersonal relations, and communication with others.
Individual Differences Factors	
Principle 12: Individual differences in learning	Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity.
Principle 13: Learning and diversity	Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account.
Principle 14: Standards and assessment	Setting appropriately high and challenging standards and assessing the learner and learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

Summarized from the APA Work Group of the Board of Educational Affairs (1997, November). *Learner-centered psychological principles: Guidelines for school reform and redesign.* Washington, DC: American Psychological Association.

by others can have a major influence on what any one person learns and remembers, the information learned and its associated emotional context is uniquely a learner's own. The research that is summarized in these principles derives from many fields, including psychology, education, sociology, and brain research. Research documentation can be found in Lambert and McCombs (1998); McCombs (2004, 2007); McCombs and Miller (2007, 2009); McCombs and Whisler (1997); Meece, Herman, and McCombs (2003); and Perry and Weinstein (1998).

Table 20.1 shows the 14 LCPs that are categorized into four research-validated domains and define much of what is known about learning and learners as a result of research into both. Many of these principles are consistent with recent discoveries from psychology relating to positive youth development and prevention interventions (e.g., Harter, 2012; Libbey, 2004; Seligman & Csikszentmihalyi, 2000). Note that the 14 LCPs are organized into four factors or domains: metacognitive and cognitive, affective and motivational, developmental and social, and individual differences. These domains and the principles within them provide a framework for designing learner-centered practices at all levels of schooling. They also define "learner-centered" from a research-validated perspective.

Defining "Learner-Centered"

Taken together, the four domains of the LCPs offer a holistic way of looking at how individual principles combine and interact to influence learners and learning. Research findings on which the LCPs are based confirm the four domains as follows (McCombs, 2004, 2009; McCombs & Miller, 2007, 2009):

1. *Cognitive and metacognitive*—What the intellectual capacities of learners are and how these capabilities facilitate the learning process.

2. *Motivational and affective*—The roles played by motivation and emotions in learning.
3. *Developmental and social*—The influence of various diverse aspects of learner development and the importance of interpersonal interactions in learning and change.
4. *Individual differences*—How individual differences influence learning, how teachers, students, and administrators adapt to learning diversity, and how standards and assessment can best support individual differences in learners.

This definition highlights that the *Learner-Centered Psychological Principles* apply to all learners, in and outside of school, young and old. Learner-centered is also related to the beliefs, characteristics, dispositions, and practices of teachers. When teachers derive their practices from an understanding of the *Principles*, they (a) include learners in decisions about how and what they learn and how that learning is assessed; (b) value each learner's unique perspectives; (c) respect and accommodate individual differences in learners' backgrounds, interests, abilities, and experiences; and (d) treat learners as co-creators and partners in teaching and learning. We have also recognized in our systemic research on the influence of parents and families that engaging parents as partners in their children's learning enhances students' engagement, attendance, and achievement outcomes (cf., McCombs & Miller, 2007, 2009).

What the Research Tells Us About "Learner-Centered" Definitions

My research since the early 1990s with learner-centered practices and self-assessment tools based on the *Principles* for teachers and students from K–12 and college classrooms confirms that what defines "learner-centeredness" is not solely a function of particular instructional practices or programs (McCombs, 2009; McCombs & Lauer, 1997; McCombs & Miller, 2007, 2009; McCombs & Whisler, 1997). Rather, it is a complex interaction of teacher qualities in combination with characteristics of instructional practices—as perceived by individual learners. "Learner-centeredness" varies as a function of learner perceptions, which, in turn, are the result of each learner's prior experiences, self-beliefs, and attitudes about schools and learning as well as their current interests, values, and goals. Thus, the quality of learner-centeredness does not reside in programs or practices by themselves.

When learner-centered is defined from a research perspective, it also clarifies what is needed to create positive learning contexts and communities at the classroom and school levels. In addition, it increases the likelihood of success for more students and their teachers and can lead to increased clarity about the requisite dispositions and characteristics of school personnel who are in service to learners and learning. From this perspective, the learner-centered principles become foundational for determining how to use and assess the efficacy of learner-centered programs in providing instruction, curricula, and personnel to enhance the teaching and learning process. They confirm that perceptions of the learner regarding how well programs and practices meet individual needs are part of the assessment of ongoing learning, growth, and development.

When the 14 LCPs are applied to schools and classrooms, they address each of the four learning domains. The resulting learner-centered framework provides a systemic approach to content, context, assessment, and individual learner needs. In addition, basing educational practices on LCPs provides a means for transforming education. The role of teachers changes to that of co-learners and contributors to the social and interpersonal development of students. In partnership with their teachers, students become responsible for their own learning and participate equally in determining what, how, and when they learn. The learner-centered framework adds a constant reminder that the human element cannot be left out of even the most advanced educational systems, including technology-supported networked learning communities (cf. McCombs & Vakili, 2005).

CONTRIBUTIONS OF EDUCATIONAL PSYCHOLOGY TO EFFECTIVE REFORM

In the previous edition of this handbook, I looked across the chapters in this volume and other recent work in the field of educational psychology, and identified a number of emerging trends. What were then I believed to be the most significant from my perspective included:

- Acknowledging the complexity of human behavior and the need for integrative theories and research that contextualize teaching and learning in schools as living systems that are themselves complex, dynamic, and built on both individual and relational principles.
- Looking at humans and their behavior holistically and focusing not only on cognitive and intellectual processes, but also on social and emotional processes that

differentially influence learning, motivation, and development.

- Situating the study of teaching and learning in diverse school contexts and in particular content domains with a mix of quantitative and qualitative methodologies.
- Seeing teachers as learners whose own professional development must mirror the best of what we know about learning, motivation, and development.
- Rethinking critical assumptions about human abilities and talents, reciprocity in teacher and learner roles, and the function and purpose of schooling such that we can better prepare students for productive contributions to a global world and lifelong learning with emerging technologies.
- Acknowledging the central role of learners' thinking and perceptions of their experiences in learning and motivation, for all learners in the system including teachers, administrators, parents, and students.

Now a decade later, I would still posit these trends as they are still emerging to some degree. However, I would also add the following to those listed above:

- We do not have a system that is based on individual learners and how they naturally learn. What we do have is a system unwilling to change its basic assumptions and work from the inside out rather than the outside in. It is this fatal flaw that must be addressed given the evidence from both researchers and practitioners that the problem can be solved rather simply by addressing new policies and practices that are in keeping with emerging 21st-century learning and teaching principles and technologies.
- We need a new way of thinking and a new set of assumptions that can propel us to a radically different educational paradigm that aligns what we know about learners and learning with what the world is already doing. It will also help us catch up with what many of our students already know—we are connected globally and can learn from each other in ways that are more meaningful and relevant than current schooling practices.
- When one is dealing with a rapidly changing landscape that is likely to accelerate in days and years to come, the educational system must be viewed as organic and living in service to the natural learning of people—students, teachers, administrators, and parents alike. It must be grounded on a core belief in the inherent tendency of all people to learn for a lifetime. Further, it must start with a value all can embrace: schooling and education are the fundamental means to develop each learner's unique potential to contribute to a global world in a way that is meaningful and relevant to him or her. Any other basic value will have the consequence we have already seen in the current system.

The consequences of not transforming our current educational paradigm have been acknowledged by many researchers: Too many dropouts, too many disengaged students, too many students who simply comply with more shallow learning and testing to "get through," too many students who are depressed and lack the self-confidence to be successful, and too many students who believe they can learn more of what they need in life outside of school.

We need an approach to transformation that mirrors who we are as naturally self-regulated and self-motivated agents of our own learning. We need to rethink whether we want to do things *to* and/or we want to do things *with* the natural learners (all of us) that we are for a lifetime. We need to move away from our fears about giving students and teachers choices and agency as argued by Walls and Little (2005) and Zimmerman (1998), for without choice self-regulation and responsibility cannot be developed in learners of any age or stage of development. We will not be able to close the achievement gap—a calling that grows increasingly urgent (Ceci & Papierno, 2005; McCombs, 2000a, 2003, 2004, 2007) in today's school policy environment of testing and accountability. If we do not accept this challenge, we will repeat the mistakes made for over a century in our broken system and not allow it to become the self-organizing system that we desperately need. This does not imply that student learners do not need teachers and school leaders. What it implies that *all of us are already* learners, teachers, and leaders in our natural lives.

We are in an exciting era of transformation and change, an era where the knowledge base in educational psychology has the opportunity to play a significant role in shaping our K–20 educational systems for the better. Particularly relevant to educational reform is knowledge being gained in the following areas, many of which have been highlighted in prior chapters in this volume. My intention in the earlier edition as well as now is to describe more broadly how other areas of research in the field of educational psychology are continuing to inform issues in educational reform and the design of more effective learning systems.

Dealing With Increased Student Diversity

An issue of growing concern is the record number of students entering public and private elementary and secondary schools (Lee, 2011; Meece & Kurtz-Costes, 2001). This population is more diverse than ever before, with almost 40% minority students in the total public school population. A decade ago Wong and Rowley (2001) offered a commentary on the schooling of ethnic minority children, cautioning that researchers should be sensitive to the cultural biases of their research with populations of color, recognize the diversity within ethnic groups and limit comparisons between groups, integrate processes pertaining to ethnic minority cultures with those of normative development, examine cultural factors in multiple settings, balance the focus on risks and problems with attention to strengths and protective factors, and examine outcomes other than school achievement. There is a need for comprehensive and coherent frameworks that allow differentiation of common issues (e.g., all children being potentially resistant to school because of its compulsory nature) to identify additional factors (e.g., cultural dissonance between school norms and ethnic culture norms) related to resistance to school. Multiple contexts should be studied, longitudinal studies undertaken and sophisticated statistical tools applied.

Still relevant is work by Okagaki (2001) who argued for a Triarchic Model of minority children's school achievement that takes into account the form and perceived function of school, the family's cultural norms and beliefs about education and development, and the characteristics of the child. The significant role of perceptions, expectations for school achievement, educational goals, conceptions of intelligence, and self-reported behaviors and feelings of efficacy are discussed as they influence successful strategies for the education of minority children. Home, school, and personal characteristics must all be considered, with particular attention paid to practices that facilitate positive teacher-child and child-peer interactions. Given the vital role parents and other family members play in supporting their children's academic success and engagement, they must be helped to feel welcome and acknowledged for their contributions as learning partners. The culture of the classroom must be made more visible and understandable to children from different cultural backgrounds This can be accomplished by carefully considering the depth and clarity of communications with parents, helping students and parents see the practical relevance of obtaining a good education, thinking through how what we do in schools might have stereotyping effects for students, and recognizing that families have different theories about education, intelligence, parenting, and child development.

It is generally recognized that unacceptable achievement gaps exist between minority and nonminority children and that dropout rates are higher for some ethnic groups. Earlier longitudinal research by Goldschmidt and Wang (1999) using National Educational Longitudinal Study (NELS) database on student and school factors associated with dropping out in different grades shows that the mix of student risk factors changes between early and late dropouts, with family characteristics being most important for late dropouts. Being held back was the single strongest predictor of dropping out for both early and late dropouts, but misbehaving was the most important factor in late dropouts. Hispanics are more likely to drop out than African Americans and African Americans are more likely to drop out than whites. These differences are partly accounted for by differences in family, language, and socioeconomic factors. Associations between racial groups and factors such as being below expected grade levels, working while in school, and having poor grades also contribute to the differences in cultural groups. Current statistics paint an even more serious problem as described in the sections below.

Looking More Deeply at the Diversity Issue

Eagley and Chin (2010) have objected to Klein and Wang's (2010) dichotomy between surface- and deep-level characteristics related to leadership, claiming that their distinction is far too simple. The psychological realities of human attributes such as race, ethnicity, and gender are at deeper levels than the surface of the human body. A basic principle of human judgment, correspondent inference, has shown that internal characteristics of people are inferred from their observable qualities. Stereotypes result that are not, as Klein and Wang claim, diminished over time but rather surface level characteristics get intertwined with deep level characteristics that include personality traits, values, interests, and behavioral styles. Issues of diversity must be connected with leadership theories to provide a way to incorporate diversity with leadership theories, research, and practice.

Interventions that show promise for reversing these negative trends regarding how we deal with diversity include social support and a focus on positive school climates. In my prior chapter I noted that Lee and Smith (1999) report research on young adolescents in the Chicago Public Schools that indicates there needs to be a balance of challenging and rigorous academic instruction with social support in the form of smaller, more intimate learning communities. Such a balance tends to eliminate achievement differences among students from different racial and socioeconomic backgrounds, particularly in math and reading. The biggest disadvantages in achievement are for students who attend schools with both little social support and low academic challenge/rigor. More recently, more confirmatory research has emerged, such as that by Fullan (2010), Pink (2009), and Wigfield and Wentzel (2009). Thus, social support is particularly effective when students also are in schools that push them toward academic pursuits. The balance needs to be one with a focus on learning and on learner needs.

Matching Research Methods and Models to Research on Diversity

Consistent with other emerging trends in the field of educational psychology research, developments in cognitive science and linguistics are suggesting—with strong evidence from Haas and Fischman (2010)—that people use unconscious and prototypical ways of thinking when comprehending and dealing with various types of higher educational institutions and how they are conceived. Nostalgia enters in to recollections of one's experience, as does our perceptions about whether it prepared us to be successful in today's society and world, and match our personal preferences as an academic community. Given these research findings, policy makers need to be sensitive to potential biases or misconceptions of research findings as well as how broadly or narrowly they should be applied. The most persuasive policies match what research has shown as the way in which certain prototypes can assist us in understanding decision making inherent education and also caution us to broaden our understanding of the rationality of these policies.

Where prototypical thinking may play a big role is in recent studies about the actual vs. perceived incidence of bullying. Klein and Cornell (2010) studied over ninth grade 7,400 students and 300 teachers in a large statewide sample of Virginia high schools in order to explore links between student victimization and large high schools. Results indicated that although more bullying and teasing take place in large high schools, their reports of being a victim were not associated with school size. Further, even though incidents were higher in large high schools, the rate of bullying offenses was lower. These researchers raise the possibility that the link between school size and bullying may be an illusion based on perceived frequency rather than actual rates of victimization.

As an example of the creative new directions research is moving, Deangelis (2010) makes a point relative to the health care system's use of science that could bear listening to by our field. What is important to see is that research must be much bigger and more inclusive and at the same time, also lead to real-world solutions to pressing problems that involve both care and costs. What this implies is that our research intervention models and methodologies need to follow big picture, validated principles and practices—they must lead to transformation in broken systems.

Studying Development of Academic Motivation

Work by those interested in Deci and Ryan's (1985) theory of intrinsic motivation continues to offer exciting new evidence about the importance of basic motivational concepts such as the need for competence, control, and supportive relationships. A decade ago, Ryan and Patrick (2001) studied the motivation and engagement of middle school adolescents as a function of their perceptions of the classroom social environment. Changes in motivation and engagement were found to be a function of four distinct dimensions of the environment: (1) promoting interaction (discuss with, share ideas, get to know other students, (2) promoting mutual respect (respect other's ideas, don't make fun of or say negative things to others), (3) promoting performance goals (compare students to others, making best and worst test scores and grades public, making it obvious who is not doing well), and (4) teacher support (respect student opinions, understands students' feelings, help students when upset or need support in schoolwork). In general, if students perceived teacher support and that the teacher promoted interaction and mutual respect, motivation and engagement was enhanced. On the other hand, if students perceived that their teacher promoted performance goals, negative effects on motivation and engagement occurred. Students with supportive teachers reported higher self-efficacy and increases in self-regulated learning, whereas with performance goal-oriented teachers students reported engaging in more disruptive behaviors. Ryan and Patrick conclude that becoming more student-centered means (a) attending to social conditions in the classroom environment as perceived by students and (b) providing practices that enhance students' perceptions of support, respect, and interaction.

Still of relevance is a longitudinal study of changes in academic intrinsic motivation from childhood through late adolescence by Gottfried, Fleming, and Gottfried (2001). They found that not only is intrinsic motivation a stable construct over time, but academic intrinsic motivation declines, particularly in math and science, over the developmental span. For this reason, Gottfried et al. argue that early interventions are needed to identify those students who may be at risk for low motivation and performance. Practices such as introducing new materials that are of optimal or moderate difficulty; related to student interests; meaningful to students; utilize incongruity, novelty, surprise, and complexity are recommended, as well as providing choice and autonomy (cf. Patall et al., 2010; Pekrun et al., 2010). The basic message is that all variables related to time honored principles of intrinsic motivation and meeting basic learner needs are coming into the forefront for research and practice. The urgency is to get the research message to policymakers who have the power to change and transform our current system for the betterment of learning and positive learner development.

Pink (2009) presents a wide range of evidence drawn from research and human experiences that the key to success at personal and organizational levels are three drives or natural human higher instincts (which motivation researchers such as Deci and Ryan, 1985; deCharms, 1968; and Walls and Little, 2005, have been saying for decades): autonomy or ability to direct our own lives, mastery or competence to get continually better at something that matters, and purpose or belonging so that we act in service to something larger than ourselves. The bottom line, then, is that to transform how we look at preparing educators for a rapidly evolving world we need systems that respect and honor natural learning and change principles that are based on higher intrinsic motivators that unite rather than divide us.

Understanding Learner-Centered Practices for Young Children

Our work with kindergarten- through college-age students over the past 20 years has revealed that learner-centered practices consistent with educational psychology's knowledge base and the *Learner-Centered Psychological Principles* enhance learner motivation and achievement (McCombs, 2000, 2001, 2007, 2009; McCombs & Miller, 2007, 2009; McCombs & Whisler, 1997; Weinberger & McCombs, 2001). Of particular significance in this work is that student perceptions of their teachers' instructional practices accounts for between 45% and 60% whereas teacher beliefs and perceptions only account for between 4% and 15% of the variance in student motivation and achievement. The single most important domain of practice for students in all age ranges are practices that promote a positive climate for learning and interpersonal relationships between and among students and teachers. Also important are practices that provide academic challenge and give students choice and control, that encourage the development of critical thinking and learning skills, and that adapt to a variety of individual developmental differences.

Using teacher and student surveys based on the *Learner-Centered Psychological Principles*, called the Assessment of Learner-Centered Practices (ALCP), teachers can be assisted in reflecting on individual and class discrepancies in perceptions of classroom practice and in changing practices to meet student needs (McCombs, 2001, 2007, 2009). Results of our research with the ALCP teacher and student surveys at both the secondary and postsecondary levels have confirmed that at all levels of our educational system, teachers and instructors can be helped to improve instructional practices and change toward more learner-centered practices by attending to what students are perceiving and spending more time creating positive climates and relationships—critical connections so important to personal and system learning and change.

Mismatches With Current Educational Regulations and Testing Policies

The direction—the dangerous direction—that states are taking in teacher evaluation is addressed by Stumbo and McWalters (2010). They provide seven major challenges that states will face. These challenges are already unfolding as this volume goes to press and they are becoming more serious and urgent. These are by now all too familiar challenges—understanding the limits of student assessment data, wondering about what we would know if we included the untested students, our certainties or uncertainties based on the quality of the evaluators, the balancing of individual- and team-based accountability, figuring out what else matters, considering the context and working environment, and understanding the importance of involving all stakeholders in a much larger complex system. Stumbo and McWalters understood how difficult it would and will be to work within this framework and get to a principled and ethical way to perform teacher evaluations while also broadening the network to include business and community leaders and other experts to insure quality schooling.

Malmberg, Hagger, Burn, Mutton, and Colls (2010) investigated in a collaborative global and national study of 17 teachers across 3 years to observe whether and how they changed their classroom quality as measured by Pianta, LaParo, and Hamre's (2006) Classroom Assessment Scoring System. Results indicated that there was more variability over time than within lessons and that the least variability was between teachers. Of interest was that emotional support was lower for older students and students were more engaged in larger classes. These results were discussed in terms of the kinds of supports most needed during transitions to professional practice. What the field needs to consider is that some relationships were linear and other were an inverted U, indicating that at the time when teachers need the most emotional and instructional support, this declines and the stress and relative isolation of new teachers once they are in their professional practice appear to be particularly detrimental to student socialization and learning. The authors conclude that now the field must focus on how student groups affect the development of teachers so that this can lead to teacher education programs that help new teachers become more aware of how their implementation practices may affect certain student groups and how they can promote all aspects of classroom quality uniformly during stressful transitions and help create more effective educational systems.

Current research findings continue to support earlier research with students who are seen as academically unmotivated. Hidi and Harackiewicz (2000) provided insights from a review of research related to academic motivation by integrating the literature on interests and goals. These authors urged educators to provide a balance of practices that are sensitive to students' individual interests, intrinsic motivation, and mastery goals—with practices that trigger situational interest, extrinsic motivation, and performance goals. This balance helps shift the orientation to an internalization of interests and motivation and promotes positive motivational development for traditionally unmotivated students. The important role of significant others (e.g., teachers, parents, coaches) was also highlighted in terms of eliciting and shaping interests and student goals. Such an intrinsic/extrinsic motivational balance is deemed essential if we are to meet diverse student needs, backgrounds, and experiences. That is, to adapt to the full range of student differences, we need the full range of instructional approaches, flexibly implemented.

The Increased Interest in and Value of Student Perceptions of Classroom Practices

The effects of student perceptions of their classroom environment on their achievement goals and outcomes is an area of emerging interest and increased understanding by those in our field and related fields. A decade ago I reviewed a study by Church, Elliot, and Gable (2001). The relationship between student perceptions and achievement outcomes was indirect, with their influence first affecting achievement goals, which influenced achievement outcomes. If undergraduate students perceived that their instructor made the lecture interesting and engaging versus whether they perceived that the instructor emphasized the importance of grades and performance evaluations or had grading structures that minimized the chance of being successful, they adopted mastery goal orientations (intrinsic motivation) versus performance goal orientations (extrinsic motivation). The authors conclude that stringent evaluation standards can lead to the adoption of performance-avoidance goals and hinder mastery goal adoption. For this reason, a study of both approach and avoidance orientations is needed in that it moves research toward a broader framework that involves more complex integration of multiple constructs.

Harter (2012) has finished her revised edition of her epic book on the self. In this book, Harter summarizes her own and others' work on a variety of aspects of self-perceptions and how they influence motivation, behavior, learning, achievement in schools, and psychological health and well-being. What is notable in this review and analysis is Harter's attention to the vast range of individual differences that influence one's positive versus negative perception of the self. She concludes by basically saying that the self may be "too-alive" as a construct as Americans are far too preoccupied with the self as a construct. A preoccupation with the self in our Western culture has been replaced by recent and emerging research and theory that places the self in a higher order systemic view that is influenced by inner and outer "realities" that are interpreted through an array of biological and contextual factors that are constantly changing over time at both the individual and broader contextual and cultural levels. In our school systems, there have been movements to enhance self-esteem rather than to promote realistic self-appraisals. Theoretically, Harter contends that discrete views of the self are inadequate to account for the pervasive influences of so many factors. She argues for more holistic, multimethod, and multilevel models to accurately describe these influences than a study of the self alone would allow and also acknowledges the central importance of self-perceptions in defining a person's "reality."

In the previous edition of my chapter, I cited work by Midgley, Kaplan, and Middleton (2001) who argued that goal theory must not be reconceptualized to focus on the positive effects of performance-approach goals. They reviewed studies that indicated there were strong negative effects of performance approach goals in terms of students' use of avoidance strategies, cheating, and reluctance to cooperate with peers. They stressed the importance of considering for whom and under what conditions performance goals are good and emphasized the need for mastery goals as an integral part of all teaching practices, particularly in this era where standards, testing, and accountability dominate education and deep meaningful learning is in short supply.

Developing Students' Metacognitive and Self-Regulation Competencies

A decade ago researchers were concerned with understanding the nature of metacognition and how it relates to the development of self-regulation competencies. Research by Lin (2001) was cited in my original chapter as an example of the power of metacognitive activities that foster both cognitive and social development. I made the point—still as true today—that to accomplish this goal, however, knowledge about self-as-learner must be part of the metacognitive approach. Knowing how to assess what they know and do not know about a particular knowledge domain is not sufficient, and Lin's research shows that knowledge about self-as-learner as well as supportive social environments help promote a shared understanding among community members about why metacognitive knowledge and strategies are useful in learning. The knowledge of self-as-learner can also be expanded to helping students know who they are and their role in specific learning cultures and knowledge domains or tasks. Thus, this research highlights the application of the knowledge base on metacognition in ways that are holistic and assist in the development of both cognitive and social skills.

New Competencies Being Investigated

As an example of where the field has rapidly moved in this past decade, Sternberg (2011) makes a strong and research-driven argument that students need to learn the steps of ethical reasoning and action as part of their overall metacognitive and cognitive development. He argues that this kind of learning is just as important as teaching students to pass tests. Ethical knowledge by itself is not sufficient; it must be translated into behavior if students are to learn first how to radon about ethical situations and then follow their reasoning with action. If students do not learn these processes (a task that is harder than it appears), Sternberg suggests that many students will leave our educational systems and be a burden ultimately to the society as a whole. He supports the view that students in this 21st century need lessons for life and not knowledge about how to succeed on tests.

Another example from a decade ago of applying research that integrates cognitive, metacognitive, motivational, and social strategies in the form of self-regulated learning (SRL) interventions is provided by S. Paris and A. Paris (2001). After reviewing what we have learned in this area, Paris and Paris define a number of principles of SRL that can be applied in the classroom:

- Helping students use self-appraisal to analyze personal styles and strategies of learning as a way to promote monitoring of progress, revising of strategies, and enhanced feelings of self-efficacy.
- Teaching self-management of thinking, effort, and affect such as goal setting, time management, reflection, and comprehension monitoring that can provide students with tools to be adaptive, persistent, strategic, and self-controlled in learning and problem solving situations.
- Using a variety of explicit instructional approaches and indirect modeling and reflection approaches to help students acquire metacognitive skills and seek evidence of personal growth through self-assessments, charting, discussing evidence and practicing with experts.
- Integrating the use of narrative autobiographical stories as part of students' participation in a reflective community and as a way to help them examine their own self-regulation habits.

Research-Validated Principles of Continuing Relevance

Additional principles still relevant today are suggested by Ley and Young (2001) for embedding support in instruction to facilitate SRL in less expert learners. These principles are (pp. 94–95):

1. Guide learners to prepare and structure an effective learning environment. This includes helping learners to manage distractions by such strategies as charts for recording study time and defining what is an effective distraction-free study environment for them.
2. Organize instruction and activities to facilitate cognitive and metacognitive processes. This includes strategies such as outlining, concept mapping, and structured overviewing.
3. Use instructional goals and feedback to present student monitoring opportunities. This includes self-monitoring instruction and record keeping.

4. Provide learners with continuous evaluation information and occasions to self-evaluate. This includes helping students evaluate the success of various strategies and revising approaches based on feedback.

Redefining Intelligence and Giftedness

As pointed out in this volume, there is a growing movement in theory and practice to reconceptualize what is meant by intelligence and giftedness. For example, some researchers are now capturing the more holistic view of what these concepts mean in school settings. In a study of 196 ninth-grade students, Schwamborn, Mayer, Thillmann, Leopold, and Lautner (2010) found that students instructed to create drawings while learning scientific text to explain the chemical process of doing laundry with soap and water scored higher than students who only read. These results held up on subsequent tests of transfer, retention, and drawing. Students who were instructed to generate drawings during learning and were able to generate high-accuracy drawings scored higher than students with low-accuracy drawings on all three tests. It was concluded that drawing can serve as a self-initiated or generative activity and as a prognostic or predictive tool. In general, they were helping the field to redefine the natural learning processes and natural kinds of intelligences that can be drawn forth in instructional activities that tap into creativity and generative learning activities.

Rethinking Intelligence

In a similar emerging trend, Campitelli and Gobet (2010) examined Simon's research from the 1950s into the 1970s on processes that are part of human decision making. The goal of this research review was to critically examine whether current research confirmed these principles in spite of the fact that Simon's efforts have not led to any impact on the researchers in the decision-making community. Some researchers were found to have explored in subsequent research programs Simon's notions about biased decision making and bounded rationality. However, Simon's research-validated assessment tools were ignored, and Campitelli and Gobet made a strong case that an integration of Simon's approach with main current approaches to decision making would lead to better models that are more generalizable, have higher ecological validity, include a more parsimonious specification of cognitive processes involved, and lead to a better undersanding of the interaction between cognitive system characteristics and contingencies of the environment or context. From my perspective, this is one example where older research that has been ignored and is demonstrating value in recent work, indicating that the wisdom of prior research can illuminate processes related to intelligence, learning outcomes, and ways in which to help educators and policymakers make more informed and principle-based decisions. Capitalizing on older findings can have an impact on how the educational system must be reformed and transformed that is grounded in validated principles and practices.

Also of continuing relevance is the work of Howard Gardner cited in my earlier chapter. In an interview by Kogan (2000), Gardner strongly argued that schools should be places where students learn to think and study deeply those things that matter and have meaning, and that help students learn to make sense of the world. He advocated a three-prong curriculum aimed at teaching—through a multiple intelligences approach—truth, beauty, and goodness. To teach truth, Gardner believes children need to understand the notion of evolution, including species, variation and natural selection, and an appreciation of the struggle among people for survival. To teach beauty, Gardner would choose Mozart's *The Marriage of Figaro* as a pinnacle of beauty that portrays characters with deeply held emotions, offers the opportunity to help students appreciate other works of art, and inspires new creations. To teach goodness, Gardner would help students understand a sequence of events such as the Holocaust, which shows what humans are capable of doing in both good and bad ways and provides a way for students to learn how others deal with pressures and dilemmas. Methods such as dramatic, vivid narratives and metaphors are recommended for involving students in their learning.

Other developments that were new a decade ago are still influencing our understanding of intelligence. These continue to include interdisciplinary social science and neuroscience fields of research that can offer multiple perspectives on complex human phenomena. Ochsner and Lieberman (2001) described the emergence of social cognitive neuroscience as one example of such an interdisciplinary approach with three levels of analysis: a social level concerned with motivational and social factors influencing behavior and experience; a cognitive level concerned with information processing mechanisms that underlie social level phenomena; and a neural level concerned with brain mechanisms that instantiate cognitive processes. This interdisciplinary field has grown in prominence and contributed much to our recent understanding of how the brain works in metacognitive, cognitive, motivational, and emotional processes and is now rapidly providing new insights about human functioning that can be useful in studying learners and learning in complex living systems such as schools. It also follows the trend toward more integrative and holistic research practices.

Rethinking Giftedness

Consistent with this integrative trend, prior work that I cited by Robinson, Zigler, and Gallagher (2000) remains valid today. They studied the similarities and differences between people at the two tails of the normal curve, the mentally retarded and the gifted. As operationalized in tests of intelligence, deviance from the norm by performance two standard deviations from the mean (IQ of 70 to 75 or lower or IQ of 125 to 130 or higher) typically defines individuals who are mentally retarded or gifted, respectively. In looking at educational issues, Robinson et al. raised the following points that remain valid today:

- A one-size-fits-all paradigm for education does not accommodate individual differences in level and pace of learning, creating major problems for meeting the needs of diverse students in the current system designed for the average student.
- Strategies and approaches that work well with gifted children need to become models for improving the school experiences of all children.
- The basic philosophies and values of U.S. schools are in keeping, at least theoretically, with the concept of adapting to individual differences in abilities, thereby providing an opportunity for our schools to become models of how best to deal with students in the two tails of the normal curve.
- More work is needed to solve the problems of economic and ethnic disadvantages that skew distributions of IQ scores leading to discrimination by gender, race, and ethnic origin in terms of overplacement of minority students in special services and underrepresentation of minority students in gifted services.
- Research agendas in areas such as neurodevelopmental science, brain function, and genetics need to look at both ends in longitudinal studies that can provide insight into how to design interventions that overcome current maladaptive approaches to learning and performance that can hinder retarded and gifted students.

The updated bibliography for this chapter includes many current examples of neuroscience and other emerging research that continues to inform our field along with practice and policy in this 21st-century world (e.g., R. Caine & G. Caine, 2011; Floresco, 2011; Van Gog et al., 2011; Walls & Little, 2005; Wentzel & Wigfield, 2009).

Understanding Components of Effective Teachers, Teaching, and Teacher Development

The past two decades of research have seen an increased focus on teaching, teachers, and teacher education. Part of this increased attention is due to a growing understanding of the nature of learning and the role of teachers as lifelong and expert learners. As our own research has repeatedly found, enhanced organizational functioning (functioning that supports meaningful learning and engages all learners in lifelong learning processes) *requires* a supportive environment in educator preparation programs as well as in the schools in which they serve—one that gives teachers and all school leaders the time to reflect, discuss, share experiences, and receive social and emotional support (Deakin-Crick et al., 2007; McCombs, 2004). This is what allows teachers to be able to deal with aversive, non learner-centered school policies and requirements as well as how to deal with negative student reactions to these policies (McCombs & Miller, 2007, 2009).

To demonstrate local and national involvement, my colleagues and I are part of a nationwide team of renowned professors and leaders in education who are deeply concerned about K–12 education. Over the past year we have been meeting and communicating often and are about to embark on the development of a K–12 education transformation/solution. We have come to an important conclusion: *You cannot copiously and effectively educate the diversity of man with uniformity*. This applies directly to the way we are preparing future educators for our rapidly evolving world. It applies in the following policy recommendations:

- Programs need to provide participants with opportunities to experience as well as learn the knowledge base on human learning, motivation, development and individual differences. It is no longer sufficient that educators learn only practices and strategies.
- Programs need to embrace collaborative and real-world learning experiences that get educators involved in the real world of teaching and leading. Classroom learning for future educators needs to mirror what they will need to create in their own school settings while building personal confidence for trusting in the human capacity to do the right thing for their particular school culture and community.

- Programs need to encourage personal visionary leadership and the ability to share leadership in the pursuit of quality teaching, learning, and leading in their particular contexts. Participants need to learn and to experience that all learners, including students, must have a voice and say in their own learning and be able to experience mastery and success against their own personal capacities and interests and talents.
- Programs need to help participants form lifelong relationships and networks of support as they embark on transforming the current system to one that serves all learners in the pursuit of their personal purpose and life work. This means preparing future educators to be catalysts for lifelong learning and change for all learners so they leave formal systems with the holistic 21st-century skills and knowledge needed to be productive and purposeful contributors to a new global world and community.

Still of relevance from my prior chapter is Hoy's (2000) identification of the need to place learning at the center of teaching, which means that teachers must have both deep content knowledge and a deep understanding of learning, motivation, and development. More than a decade ago, she described shifts in teacher education toward more integrative study that contextualizes content and pedagogical knowledge in social environments and inquiry-based curricula. Collaboration between and among students and teachers at all levels of schooling was identified as another trend, along with encouraging reflection and field-based experiences. Other more current research by Hoy and others in our field is reviewed in my recent chapter for the *Handbook of Motivation at School* (McCombs, 2009; Wentzel & Wigfield, 2009). In addition, Levine (2010) at Teacher's College, Columbia, takes the message even further and maintains that the whole system of teacher education must wake up and adapt to the larger societal changes in the economy, demographics, and other changes such as globalization that are promoting and even forcing changes in public education.

Defining Effective Teachers

An example of the enduring and visionary nature of our work as a field on these issues is a study I reported in my earlier chapter by Van den Berg and Ros (1999). This research reminds us that teachers have individual questions, needs, and opinions about innovations and reform initiatives that must be attended to in any reform process. Using a concerns-based approach, different types of concerns were revealed at different stages of the innovation process, pointing to the need to attune innovation policies to these factors. Three clusters of concerns were identified by Van den Berg and Ros: self-worries (e.g., amount of work involved in the innovation), task worries (e.g., classes are too big to accommodate the innovation), and "other" worries (e.g., getting older colleagues to implement the innovation). The teachers' concerns varied as a function of stage of the innovation (adoption, implementation, institutionalization), with self-worries more apparent in the adoption stage, task worries emphasized more in the implementation stage, and more "other" worries present in the institutionalization stage. The authors concluded with a plea to include opinions of teachers as well as orientation toward uncertainty in reform efforts and to provide explicit opportunities for reflection and dialogue in ongoing workshops and seminars. Given the current concerns of teachers in our rapidly changing political and educational landscape, this research is even more relevant today.

Also of growing relevance is the importance of collective teacher efficacy for student achievement that was explored by Goddard, Hoy, and Hoy (2000). Collective teacher efficacy is defined as the perceptions of teachers in a school that the efforts of the faculty as a whole will positively impact students. A measure was developed and validated, and was shown to have a positive relationship with student achievement in both reading and mathematics. It was also shown to differentiate achievement differences between schools, with higher levels of collective teacher efficacy being related to gains in reading and mathematics achievement. When teachers share a sense of efficacy, they act more purposefully to enhance student learning and are supported organizationally to reflect on efforts that are likely to meet the unique needs of students. Current research continues to bear out these findings.

Defining Effective Teaching

Another critical variable is the degree to which teachers believe that instructional choice promotes learning and motivation. In spite of a large literature documenting the positive effects of choice, particularly on affective areas such as interest, ownership, creativity, and personal autonomy, many teachers continue to limit student choice. This is particularly true is the growing number of failing schools in many states and across our nation and world (e.g., Fullan, 2010; Hannum & McCombs, 2008; Levine, 2010; Malmberg et al., 2010). Many are now expressing a sense of urgency and identifying new ideas such as the importance of starting with the wisdom of practitioners who know from years of educational experience what it means to implement creative and innovative solutions. These educators are increasingly being urged to work with researchers and others in their communities in identifying what works for students in their school and community contexts. Many are concerned that the political scene is fraught with too many rapidly changing and fragmented—even piecemeal—priorities that are getting in the way of innovative solutions to pressing educational issues.

Educators are continuing to recognize the importance of choice, for example, as a motivational principle needed for all learners, including the teachers themselves. Still relevant is research by Flowerday and Schraw (2000) who interviewed 36 practicing teachers to examine what, when, where, and to whom teachers offer choice. Among the findings were that teachers with high self-efficacy are more likely to provide instructional choices, as are teachers who themselves feel intellectually and psychologically autonomous and who are more experienced in particular subject areas. Most or all teachers agreed that choice should be used (a) in all grades, with older students needing more choices; (b) in a variety of settings, on different tasks, and for academic and social activities; and (c) in ways that offer simple choices first, help students practice making good choices, use team choices for younger students, provide information that clarifies the choice, and offer choices within a task.

Defining Effective Teacher Development

In keeping with how our field has been advocating these approaches for more than a decade, still of relevance is research on the impact of teacher education on teachers of secondary mathematics that has been described by Borko et al. (2000). For teacher education to make a difference, it is argued that both university experiences and field placements need to share comparable visions of reformed practice and teacher learning as situated in reformed practice. Such practice has methods situated in the content area (e.g., mathematics) and uses learning tasks that encourage multiple representations, solution strategies, and actively involve students in the learning process (e.g., having them make conjectures, provide justifications and explanations, and draw conclusions). Similarly and more than a decade ago, Zech, Gause-Vega, Bray, Secules, and Goldman (2000) described a professional development model, Content-Based Collaborative Inquiry (CBCI), which engages educators in inquiring and constructing their own knowledge with a focus on their own and their students' understanding and learning processes. Sustaining communities of inquiry to support lifelong teacher learning and educational reform is discussed as a way to shift practicing teachers' orientations toward knowledge and knowing. By helping teachers focus on students' understanding in content domains, teachers' critical reflection and assessment of their content knowledge and practice occurs. Collaborative inquiry helps uncover assumptions and build communities of practice based on trusting relationships.

New learner-centered professional development models for teachers are continuing to focus on examining beliefs, empowerment, teacher responsibility for their own growth, teachers as leaders, and development of higher-order thinking and personal reflection skills (e.g., Darling-Hammond, 1996, 2010; Fullan, 1995, 2010; McCombs, 1997, 2007). A key to teachers' abilities to accept and implement these learner-centered models is support in the form of self-assessment tools for becoming more aware of their beliefs, practices, and the impact of these practices on students. Information from teachers' self-assessments can then be used by teachers to identify—in a nonthreatening and nonjudgmental context—the changes in practice that are needed to better serve the learning needs of all students. In this way, teachers can begin to take responsibility for developing their own professional development plans.

A number of researchers are creating instruments to help teachers at all levels of the educational system (K-20) look at their own and their students' perceptions of their learning experiences (cf. Deakin-Crick et al., 2007; McCombs, 2009; McCombs & Miller, 2007, 2009; Wentzel & Wigfield, 2009). To date, however, these tools are available in innovative teacher preparation programs and are not prevalently used in higher education in general, due in large part to reluctance among many college administrators to change current evaluation procedures that are based on a direct instruction rather than holistic and constructivist models of teacher classroom practices. In addition, changes in evaluation procedures are occurring in teacher education, and current approaches support teacher growth with learning opportunities that (a) encourage reflection, critical thinking, and dialogue and (b) allow teachers to examine educational theories and practices in light of their beliefs and experiences. For teachers to change their beliefs to be compatible with more learner-centered and constructivist practices, however, they need to be engaged in reflective processes that help them become clearer about the gap between what they are accomplishing and what needs to be accomplished. Reflection is defined by Loughran (1996) as a recapturing of experience in which the person thinks about it, mulls it over, and evaluates it. Thus, Loughran argues that reflection helps develop the habits, skills, and attitudes necessary for teachers' self-directed growth—an argument that holds true today as a principle of quality teacher development and ongoing learning.

The work of my colleagues and I in developing a set of self-assessment and reflection tools for K–20 teachers (the Assessment of Learner-Centered Practices, ALCP) in the form of surveys for teachers, students, and administrators, combines aspects of these approaches (McCombs & Lauer, 1997; McCombs & Miller, 2007, 2009; McCombs & Whisler, 1997). However, the focus is on identifying teacher beliefs and discrepancies between teacher and student perspectives of practices that can enhance student motivation and achievement—as a tool to assist teachers in reflecting on and changing practices as well as identifying personalized staff development needs. This work has looked at the impact of teacher beliefs on their perceptions of their classroom practices as well as how teacher perceptions of practice differ from student perceptions of these practices (Hannum & McCombs, 2008; McCombs, 2009; McCombs & Lauer, 1997, 1998; McCombs & Miller, 2007, 2009; McCombs & Vakili, 2005; McCombs & Whisler, 1997).

In a large-scale study of teachers and students we confirmed our hypothesis about the importance—for student motivation, learning, and achievement—of those beliefs and practices that are consistent with the research on learners and learning. We also found that teachers who are more learner-centered are both more successful in engaging all students in an effective learning process, and are, themselves, more effective learners and happier with their jobs. Furthermore, teachers report that the process of self-assessment and reflection—particularly about discrepancies between their own and their individual students' experiences of classroom practices—helps them identify areas in which they might change their practices to be more effective in reaching more students. This is an important finding that relates to the "how" of transformation. That is, by helping teachers and others engage in a process of self-assessment and reflection—particularly about the impact of their beliefs and practices on individual students and their learning and motivation—a respectful and nonjudgmental impetus to change is provided. Combining the opportunity for teacher self-assessment of and reflection on their beliefs and practices (and the impact of these practices on individual students) with skill training and conversations and dialogue about how to create learner-centered K–20 schools and classrooms can help make the transformation complete.

Our research also revealed that teachers were not absolutely learner-centered or completely nonlearner-centered. Different learner-centered teachers had different but overlapping beliefs. At the same time, however, specific *beliefs or teaching practices* could be classified as learner-centered (likely to enhance motivation, learning, and success) or nonlearner-centered (likely to hinder motivation, learning, and success). Learner-centered teachers are defined as those that have more beliefs and practices classified as learner-centered than as nonlearner-centered. For example, *believing all students learn* is quite different *from believing that some students cannot learn*, the former being learner-centered and the latter being nonlearner-centered. Learner-centered teachers see each student as unique and capable of learning, have a perspective that focuses on the learner knowing that this promotes learning, understand basic principles defining learners and learning, and honor and accept the student's point of view (McCombs, 2009; McCombs & Lauer, 1997). As a result, the student's natural inclinations to learn, master the environment, and grow in positive ways are enhanced.

Capitalizing on Advances in Teaching and Learning Technologies

In a review of emerging e-learning environments, McCombs and Vakili (2005) point out that recent efforts to infuse electronic networking into school buildings via the Internet and *e-rate* promise to promote connections among teachers and students in classrooms and those in the community at-large. An e-rate is a well-known term that refers to heavy discounts to schools and libraries in terms of computers, Internet access, and various other telecommunication items that are necessary within schools. At the same time, uses of electronic networks for educational purposes cause large disturbances to the close-ended nature of 20th-century classroom practices (Ackerman, 2010; R. Caine & G. Caine, 2011; Dede, 2009; Heflich, 2001; Jones, 2001; Jukes et al., 2010; McNabb, 2001). What becomes apparent when the one-size-fits-all industrial or factory education model is compared with the personalized and individualized ways of learning possible with e-learning are misalignments among curricular goals and resources, instructional practices, assessments, and accountability policies governing learning activities. The current shortage of qualified teachers available to the nation's children on an equitable basis provides an additional challenge and opportunity for systemically transforming the nature of schooling to better meet the needs of 21st-century learners.

Many countries around the world are taking the research messages from our field to heart in transforming outdated traditional systems with emerging technologies and conceptions of what supports learner-centered education for today's students. Still relevant from a decade ago is the message from Haywood (personal communication, University of Edinburgh and Open University, June 15, 2001). He then argued that to overcome built-in inertia in traditional systems and the people they serve (students, teachers, administrators) requires new forms of learning, assessment, and community. New forms of communication that emerge in e-learning cultures may lead to new and better forms of socialization. Some of the bigger challenges in distance learning have been in how to help people handle change and in supporting new educational processes while working within the dominant traditional systems (e.g., Fullan, 2010). The implementation issues range from determining the number of computers needed to how they are used and how much they are used (Hannum & McCombs, 2008; McCombs & Vakili, 2005).

Current and ongoing research at the Open University and other European institutions supporting some form of e-learning (e.g., Deakin-Crick et al., 2007) is now focusing on identifying the range of individual and group learning outcomes that must be assessed in both formative and summative ways. Other issues include finding new ways of communicating (Barnes, University of Bristol, personal communication, June 19, 2001; Hannum & McCombs, 2008) and identifying new social learning outcomes that result. Current challenges include communicating across several mediums in e-learning environments, looking at change over time, and finding ways to reward risk taking at the personal and institutional levels as traditional K-20 systems make steps to change current learning and assessment paradigms.

Taking up the challenge of building learner-centered and technology-based classrooms, many are implementing novel and creative solutions. My earlier example from Orrill's (2001) research remains relevant today. He described how teachers can be supported toward this goal with professional development that includes reflection, proximal goals, collegial support groups, one-on-one feedback, and support materials for teachers. The framework was based on the assumption that change is individual but must be supported over time in the social context of schools. Data were collected on 10 middle school teachers using simulations in project-based learning over a four-month period. Refinements to the professional development framework included helping teachers to develop reflective skills prior to using proximal goals to focus reflection activities. Outside resources, one-on-one feedback, and collegial group meetings are then used to enhance the interplay between reflection and proximal goals. Guidance continues to be essential as part of the development of reflection such that teachers see the importance of focusing on learner-centered goals that can be enacted immediately in refining the simulation activities (e.g., Dede, 2009; Jukes et al., 2011).

Significant in using emerging technologies is the use of personalization strategies. Just as Lin (2001) found higher levels of social development and achievement when metacognitive activities included self-as-learner knowledge, Moreno and Mayer (2000) report that personalized multi-media messages can increase student engagement in active learning. In a series of five experiments with college students, personalized rather than neutral messages resulted in better retention and problem-solving transfer. The importance of self-reference to student engagement and motivation has a long-standing research base, but it appears to be especially important in technology-based learning, particularly as it also influences higher learning outcomes.

The issue of scaling up technology-embedded and project-based innovations in systemic reform continues to be an important issue for our field. This was addressed by Blumenfeld, Fishman, Krajcik, Marx, and Soloway (2000). Studying urban middle schools, a framework is used to gauge the "fit" of these innovations with existing school capabilities, policy and management structures, and the organizational culture. The authors argue that the research community needs to create an agenda that can document how innovations work in different contexts and how to select reforms that match outcomes valued in their community and that are compatible with state and national agendas. Collaboration with teachers and administrators not only can help them adapt the innovation so that is achievable, it can also promote an understanding of what will be require for sustainable systemic innovations that challenge traditional methods.

Of significance in this work with technology-based teaching and learning systems is the growing agreement that what we know about learning, motivation, development and effective schooling practices will transfer to the design of these new systems (Hannum & McCombs, 2008; McCombs, 2009; McNabb & McCombs, 2001). What we have learned that is particularly applicable continues to include findings summarized earlier and in many of the chapters in this volume: comprehensive dimensions of successful schools and learning environments must be concerned with (a) promoting a sense of belonging and agency, (b) engaging families in children's learning and education, (c) using a quality and integrated curriculum, (d) providing ongoing professional development in both content and child development areas (including pedagogy), (e) having high student expectations, and (f) providing opportunities for success for all students (see reference list and particularly work by Cornelius-White, 2007; Deakin-Crick et al., 2007; Efklides, 2011; Fullan, 2010; Lee, 2011; Lee & Shute, 2010; McCombs & Miller, 2007, 2009).

Building New Learning Communities and Cultures

With this knowledge and wisdom, McCombs (2009, in press a & b) argues that we can achieve an increasingly united and global community of learners—including the students themselves and their teachers—who become dynamic, self-organizing members of an interconnected and interrelated social network and collaborative learning community. The challenge in our rapidly evolving world is to work together with a new set of core principles and values that we can all embrace without arguing about what happens at the fringes. Can we let those practices naturally evolve in the diverse, natural, and organic way that creates learner-centered systems that are culturally and contextually responsive to learner and community needs at the educator preparation level?

In most institutions of elementary, secondary, and higher education and progressively within professional development programs, teachers, administrators, policymakers and those in content area disciplines are isolated from each other. It is difficult to find examples of cross-department collaborations in course design, multidisciplinary learning opportunities, or organizational structures and physical facilities that allow interactions and dialogue among a range of educational stakeholders. Schools are isolated from emerging content in professional disciplines. Change is often mandated from above or outside the system. Critical connections are not being made and it is not difficult to foresee that change is then difficult and often resisted because of personal fears or insecurities. Those fears and insecurities disappear when people participate together in creating how their work gets done.

In developing effective learning communities and cultures, it is important to see the role of educational psychology's knowledge base and the principles derived from this knowledge base in a systemic context. It is important to understand that education is one of many complex living systems that functions to support particular human needs (cf. Wheatley, 1999, 2010). Even though such systems are by their nature unpredictable, they can be understood in terms of principles that define human needs, cognitive and motivational processes, interpersonal and social factors, and development and individual differences. A framework based on research-validated principles can then inform not only curriculum, instruction, and assessment, and related professional development but also organizational changes needed to create learner-centered, knowledge-centered, assessment-centered and community-centered practices that lead to more healthy communities and cultures for learning.

Effective schools function as a healthy *living system*: an interconnected human network that supports both teachers and students, and their relationships within communities of expert practice. In placing emphasis on the learner-centered developments of both students and teachers (as "expert learners"), within the context of emerging technologies, educational psychology's knowledge base can be applied to building a fully functioning living system. This system supports a community network of members who are connected and responsive to each other. Community members interact in ways that precipitate learning and social development, on all levels of the system. With the recent infusion and development of new and innovative technologies, researchers and scientists have imagined and implemented a wide range of methods for making this goal attainable.

Studies about the impact of the Internet on society and communities show that people, in general, are using the Internet at home, at the library, and at work for a variety of purposes including informal learning—a phenomenon the began more than a decade ago and that is continuing to grow at exponential rates and on a global scale (e.g., Berry, 2011; Bollier, 2000; R. Caine & Caine, 2011; English-Lueck, 1998; Nie & Erbing, 2000; Shields & Behrman, 2000). Children are finding connections to basic and advanced knowledge available in and generated through the community that can conflict with textbooks. Youth's career exploration and teachers' professional development is best served in the community arena. Geographic cultures are converging electronically with other cultures via networks that allow easy movement in and out of many cultures. McNabb (2001) points out that, historically, research shows positive cultural experiences, based on mediated interactions with others, are a vital part of children's personal and interpersonal development that fosters one's overall ability to learn (Boyer, 1995; Csikszentmihalyi, 2003; Dewey, 1990; R. Feuerstein & Feuerstein, 1991; Vygotsky, 1978).

Wilson (2001) as reviewed in my prior chapter explains that "culture" refers to the set of artifacts and meanings (norms, expectations, tools, stories, language and activities, etc.) attached to a stable group of people associating with each other. Thus each of us is, in a sense, multicultural and multilingual as we adapt to different cultural norms required by different groups and allegiances, a phenomena that can proliferate on the Internet. It is community that helps bring coherence to our multicultural experiences. Wilson identifies belonging, trust, expectation, and obligation as defining characteristics of community. A sense of *belonging* within the community pertains to common purposes and values, and *trust* in acting for the good of the whole. Community carries an expectation among its members that the group provides value, particularly with respect to each other's learning goals and with that a sense of *obligation* to participate in activities and contribute to group goals.

In addition, evidence shows that electronically networked cultures and communities are causing shifts related to control of these new cultures for learning. In the 20th-century industrial era, the focal point within school systems tended to pertain to goals generated externally (top-down) with mass production designs for curriculum, instruction, and assessment purposes (Joseph & Reigeluth, 2005; Reigeluth, 2001, 2005). In 21st-century culture, the focal point is shifting to customized learning experiences and personal learning plans with goals based on each learner's personal needs and interests. These tailored learning opportunities are facilitated by learner-centered pedagogy, combined with content area understanding that is customized to learner needs along a continuum from novice to expert. Students' self-directed learning skills are developed through access to knowledge-centered materials and human resources in the community. The learners' needs and achievements are continually identified by formative assessments aligned to personal learning plans using assessment-centered feedback loops.

Finally, the foregoing research, needs, and challenges facing today's learners in K-20 systems also face preservice and in-service teachers. Researchers are increasingly calling for learning and professional development approaches that lead to "Emerging Communities of Practice" (Hannum & McCombs, 2008; McCombs & Vakili, 2005) This is in keeping with the recognition that e-learning technologies allow for non-linear emergent learning and new paradigms of assessment. Emerging technologies also allow for various learning communities and cultures, including communities of interest, communities of sharing, and communities of caring—all of which can be part of the experience at various points in time and contribute to both higher engagement and higher learning outcomes (cf., Ackerman, 2010; Allen & Seaman, 2007; R. Caine & G. Caine, 2011; Dede, 2009; Duffy & Kirkley, 2004; Jukes et al., 2011; McCombs & Miller, 2007, 2009; Penuel & Riel, 2007; Richardson, 2006; Roblyer, 2006; Rosen, 2011).

WHAT RESEARCH DIRECTIONS ARE NEEDED?

This section provides what I continue to see as basic and applied research directions that can foster the usefulness of educational psychology's contributions to education and educational reform during the 21st century. Although educational psychology is generally thought of as an applied field, basic as well as applied research directions suggested in *Handbook* chapters will be summarized and others added from my perspective. All of these directions will then be considered in light of implementation and evaluation implications as they are applied in the context of school and teacher accountability issues. This section concludes with a summary that pulls research findings together.

Basic Research Directions

In making the knowledge base from educational psychology more visible and accessible to educators and policymakers, some basic research directions are needed. Findings from laboratory studies versus the real world contexts of applied research define main differences between these research categories. From the preceding chapters in this volume and my own perspective, a number of suggestions can be made for basic research, including:

- Research that can further refine and elucidate alternative conceptions of ability and intelligence and broaden our understanding of the interplay between cognitive, affective, neurobiological, and social factors that influence the development of competencies.
- Research on voluntary study groups, effective uses of problem-based learning, intersections of cooperative learning and curriculum, strategies for professional development and follow up support for cooperative learning, and how well cooperative learning works for gifted students or other students at the margins.

- Research on adult literacy, along with more research on how teaching word recognition also affects normal and gifted readers (not just struggling readers) and how to develop teachers to deliver motivational reading and writing programs.
- Research on the cultural aspects of learning and contrasts between activity theory and contextualism as alternative views for understanding the sociocultural context of the teaching and learning process.
- Research that explores relations between self-regulation and volition, the development of self-regulation in children, self-regulation and the curriculum, and self-regulation across the lifespan.

Applied Research Directions

Along with these basic research directions, more research is needed on the real world contexts of learning environments and the complex interactions between personal, organizational, and community levels of learning in schools as living systems. This includes attention to applied research in the following areas:

- Research on teacher development including what teachers cite as the biggest challenge—the students themselves. Excellent teaching is called a complex balancing act and there are no quick fixes to producing excellent teachers.
- Research on what can be learned about learning and human adaptability to change during the implementation phase as new and existing teachers and others in our existing places called school begin to increasingly use e-learning technologies in new ways. These new ways of learning promise to be the catalyst to systems change and a new paradigm for learning and assessment within electronically networked schools.
- Research to better understand the comprehensive dimensions of successful schools as (a) promoting a sense of belonging and agency, (b) engaging families in children's learning and education, (c) using a quality and integrated curriculum, (d) providing ongoing professional development in both content and child development areas (including pedagogy), (e) having high student expectations, and (f) providing opportunities for success for all students.
- Research to identify the best socialization experiences for positive adjustment with diverse student populations, examining how children's understanding of rules and norms change and how these are complementary or compatible with peer and adult norms, what differential impacts reward structures that teachers establish have depending of students' age and family environment, and further work on student beliefs and perceptions of social support from teachers and peers.
- Research that identifies teacher preparation practices that can foster of the development of metacognition in students and the application of metacognition to their own instruction.
- Research on school-based methodologies for studying the complex interrelationships between and among individual, organizational, and community levels of learning and functioning that can provide solid and credible evidence to support conclusions about causal connections between variables.

Producing Credible Research: Implementation and Evaluation Considerations

Educators, researchers, and policymakers are increasingly recognizing the need for new evaluation strategies and assessment methods that are dynamic measures of learning achievement and learner development aligned with multiple types of formative and summative outcomes (e.g., Broadfoot, 2001; Clay, 2010; Gipps, 2001; McCombs, 2009; McNabb, Hawkes, & Rouk, 1999; Popham, 2001; Stiggins, 2001; Wiggins & McTighe, 1998; Winne, 2010). As people increasingly use the Internet for educational purposes, evaluation strategies and assessment methods that can fully capture the complexity, flexibility, and open-ended nature of the learning processes and outcomes in networked communities are needed. Shepard (2000) earlier called for recognizing that different pedagogical approaches need different outcome measures. Most of our current accountability systems are based solely on high-stakes scores pertaining to knowledge-transmission outcomes while research findings on how people learn and what is needed for 21st-century citizenry pertain to achieving knowledge-adaptation and knowledge-generation, higher-order thinking, technological literacy, and social-emotional outcomes (Bransford, Brown, & Cocking, 1999; Carroll, 2001; Groff, 2001; McCombs, 2001; McNabb, 2001; Ravitz, 2001; Repa, 2001).

Evaluation and assessment designs need to be based not only on knowledge-centered principles, but a combination of community-centered and learner-centered principles as well. Some learning communities thrive while others get started and dissipate. Development of new evaluation strategies and assessment methods will lead to an understanding of what makes particular communities viable and how best to support learning in both on- and off-line learning communities. Assessment measures can be designed to provide data about the balance between individualized and group learning processes, instructional strategies and activity structures, and outcomes within different types of learning communities (McCombs, 2000, 2007, 2009).

Research and Evaluation Issues in Technology-Based Learning Environments

A host of other issues that will expand into the 21st century concern the growth of technology-based learning environments. In such environments, educational psychologists can play a central role in defining research and evaluation data requirements. For example, data collected in technology-based environments may be required to calibrate the online "school climate" and address research-based concerns about the negative effects of the distal nature of online relationships and the amount of time these distal relationships take away from close, more nurturing, relationships (e.g., Hannum & McCombs, 2008; McCombs, 2001; McCombs & Vakili, 2005; McNabb, 2001; Repa, 2001). Earlier research conducted by Kraut et al. (1998) indicates that a unit of measure with which to assess social ties in cyberspace is needed to foster the development of children's overall mental, social, and physical health and well-being.

Building such measures on what we have learned is essential. What is emerging in our 21st-century digital world is another set of issues that have researcher and practitioners as well as policy makers thinking outside the box about what kinds of assessments contribute to learning and how they should be part of personalized learning systems. Those who are contributing to an expansion of our thinking and leading the way in transforming current punitive and disruptive practices are the topic of the next section.

Expanding the Standards and Assessment Agenda

Other measurement and evaluation challenges concern the balancing of content knowledge gains against other nonacademic educational goals. Currently our educational systems have a proliferation of standards competing for the attention of teachers and students. Dede (2000) and Marzano (2005) point out that no one person can possibly meet all the standards that many states are now requiring of teachers and students. This phenomenon is indicative of a knowledge transmission mode of operating. In a traditional transmission of knowledge learning situation, not knowing has resulted in disadvantages to some learners in terms of future learning opportunities and decisions made based on high-stakes assessment scores. But, in a knowledge-generation learning situation, not knowing provides the foundation for inquiry and calls for *assessment-centered* practices for feedback and revision (e.g., R. Caine & Caine, 2011; Carroll, 2001; Bransford et al., 1999). The new types of formative and summative assessments, described earlier, that researchers and evaluators are calling for rely on communities in which learners have trusting relationships, where they feel comfortable enough to admit that they didn't understand a task, where they are willing and feel safe in exposing their uncertainty (e.g., Bransford, 2001; Harter, 2012; McLaughlin, 2001; Rose, 2001; Wentzel & Wigfield, 2009; Wilson, 2001).

Our present accountability system has created an overemphasis on summative assessments with little useful feedback at the personal, organizational, and community levels. According to Braun (2001), a decade ago, the present systems tend to focus on collecting summative data needed by those most removed from schools, that is, policymakers, with those involved in the learning process. Little time is afforded to efforts needed to collect more formative data to serve the needs of those involved in shaping the learning process and thus its outcomes, that is, teachers, students, and parents. However, issues pertaining to summative assessment need to be addressed because we want students to show some ability to "transfer" their learning to new situations (Bransford, 2001; Sternberg, 2011). There are important differences between static assessments of transfer (e.g., where people learn something and then try to solve a new problem without access to any resources) versus dynamic assessments (e.g., assessments that allow people to consult resources and demonstrate the degree to which they have been preparing for future learning in particular areas). Portfolios properly designed can support formative data needed for learning and summative data for accountability within the community (Braun, 2001).

Formative assessment needs to combine input from all three levels of the learning community (i.e., personal, organizational, and community levels) through self-evaluation, peer critique, and expert feedback focused on conceptual understandings and "things that transfer." New evaluation strategies and assessment methods suitable for digital learning can capture learner change, growth and improvement as it occurs in networked learning communities. This will involve issues of scale noted a decade ago by Honey (2001). She suggested then that the real work of reform involves rethinking at the local level. She pointed out that we need to take seriously the challenge of working in partnership with schools and districts on terms that are meaningful to the people ultimately responsible for educating students—administrators, teachers, parents, and the students themselves—a research-based recommendation being advocated increasingly today on national and global levels (e.g., Cohen & Barnes, 1999; Deakin-Crick et al., 2007; Dede, 2009; Fullan, 2010; McCombs, 2007, 2009; McCombs & Miller, 2007, 2009; Meier, 1999; Sabelli & Dede, 2002; Tyack & Cuban, 1995). This process can perhaps best be understood as one of diagnosis—an interpretive or deductive identification of how particular local qualities work together to form the distinctive elements of the learning community. The process of adaptation through experimentation and interpretation—or what Nora Sabelli calls the *localization of innovation*—is critical to the work of reform (Fullan, 2010; Honey, 2001).

Confrey and Sabelli (2001) made an insightful call for programmatic evaluations and assessment that are informed by research that builds on and contributes to increasingly more successful implementations of innovation. Implementation research expects the system to react adaptively to the intervention, and documents how the intervention and the system interact, changing both the approach and the system. Confrey and Sabelli identify two scales of implementation research needed for sustainable, cumulative, education improvements: within project and across projects implementation research. Within project implementation research implies the need to devote resources to *project-level research.* Across project implementation research implies thinking hard about how to revise and refine funding efforts to ensure maximum learning from current efforts, and to be able to use this knowledge to inform the next round of *programmatic research*.

Pulling Research Findings Together

Much progress has been made in identifying the new research paradigms that are needed. In addition to the examples in this section, others are in the updated bibliography (e.g., Clay, 2010; Deangelis, 2010; Green et al., 2010; Stumbo & McWalters, 2010; Sun & Wang, 2010; Wai et al., 2010; Winne, 2010). These and other issues are areas where educational psychology's knowledge base will be needed.

What I have learned and written about in a recent chapter for the *Handbook of Motivation at School*, edited by Wentzel and Wigfield (2009), is the truth of the following assumptions. These apply to all learning experiences, including educator preparation.

- *What we learn about teaching, learning, and motivation from researchers is not necessarily what common sense would tell us.* Researchers can "discover truth(s)" that match what we intuitively believe or they can run counter to these intuitive and experiential understandings (our tacit knowledge).
- *When research findings run counter-intuitive to our tacit knowledge, we must discover where the error lies.* The error may lie in our tacit knowledge or in the assumptions and methodology that underlies the research findings.
- *Learners of all ages, from cradle to grave, naturally learn in self-organizing ways that are holistic and unending.* All learners come into life with an insatiable curiosity and motivation to learn. In fact, learning is self-organizing by its nature.
- *What happens to learners in school is that they begin to engage in unnatural learning in unnatural contexts and with unnaturally organized and fragmented curriculum and content divisions.* It is no surprise that learners quickly become disengaged and display disengagement or noncompliance in learning situations that do not match their needs or views of the types of knowledge and skills they must master to succeed.
- *Choice and the permission to be a natural learner are essential to lifelong learning dispositions.* Without choice and some level of control, any learner is tempted to give up personal responsibility and go with the flow. If that happens and preparation programs do not mirror contexts that inspire them to replicate and improve upon their own roles, our future educators will continue to create schools like they experienced or be afraid to step up to new leadership roles that change the paradigm in the direction it must go. They will not be prepared to create school contexts that share the responsibility with all learners to create schools as places where they want to be.
- *The way we think about motivation, learning, and teaching must change if we are to change the current state of affairs for students and those that teach them.* This means that assumptions about human capacity, learning, teaching, and motivation must be changed so that a transformational paradigm for education can emerge.

- *We must keep our research and suggestions for practitioners simple if we are to have an impact on the field and on practice.* By keeping it simple but sophisticated we have a chance of influencing policy makers who live in different worlds than ours. They need to hear our results as stories that are motivational, engaging, easy to read and understand, and easy to implement. And, if we are to make the difference in transforming the way we prepare future educators, we must design programs that actively involve future educators in creating holistic, integrative, and inclusive educational systems that match the known truths and research-validated principles and practices that do engage all learners in natural, self-organizing learning for a lifetime.

HOW CAN EDUCATIONAL PSYCHOLOGY'S KNOWLEDGE BASE BEST BE APPLIED TO EDUCATIONAL REFORM ISSUES IN THE 21ST CENTURY?

This section, as in my earlier chapter, builds on issues introduced in the prior sections and discusses them within a living systems framework for education. That is, my focus here is to discuss what I believe are ways that educational psychology's knowledge base can be applied in whole school or systemic reform efforts (in terms of both the overall organizational and personal domains in living systems); in reform efforts aimed at curriculum, instruction, and assessment (in terms of both the personal and technical domains of living systems); and in reform efforts aimed at creating new learning communities and cultures, including those in e-learning environments (in terms of both the personal and community levels of living systems). The dominance of people (the personal domain) in all levels of living systems are then discussed as the fundamental rationale for the role educational psychology can and should play in educational reform in the 21st century.

Implications for Application in Systemic Reform Efforts

A focus on the learner and the personal domain emerges from those who see schools as "living systems" (Wheatley & Kellner-Rogers, 1998). As people in living systems such as education are given more opportunities to be creatively involved in how their work gets done, standards of functioning are not imposed or mandated from outside, but rather, these standards, measures, values, organizational structures, and plans come from within—through an ongoing dialogue in which people share perceptions, seek out a diversity of interpretations, and agree on what needs to be done. In this process of learning and change, research-validated principles that are agreed on can be guides to determine what will work well in the current situation or context such that the system is designed to take care of self, others, and the place (e.g., Stewart, 2007; Suarez & Sattin, 2007; Wheatley, 2010; Wheatley & Kellner-Rogers, 1998).

A key implication is that the larger context of education must support and value individual learners as well as learning outcomes. The culture and climate must acknowledge the purpose of education as going beyond academic competence and content knowledge alone (Payton, et al., 2000). There must be a shared vision, values, and sense of inclusive ownership among all stakeholders about purpose of education. Restoring a sense of schools as caring communities is a fundamental way to provide social and emotional support.

Similar concerns about how to restore the moral dimensions of schooling were described and cited in my prior chapter by Berreth and Berman (1997) and more recently by others such as Sternberg (2011). These dimensions attempt to nurture empathy and self-discipline and to help students develop social skills and moral values. The practices of small schools, caring adults, community service, and parent involvement are recommended, along with processes and practices of modeling, direct, instruction, experience, and continual practice. The learner-centered framework can be used to accomplish these purposes. Individuals can be assisted to learn and develop high levels of self-awareness, self-control, empathy, perspective taking, and social skills in handling relationships. One guideline stressed in my prior chapter and recently researched by many is that students be active partners in creating a caring classroom climate and community (e.g., Elias et al., 1997).

Another critical implication for practice is that attention be given to the role of student perceptions and input. Freiberg (1998) and Freiberg and Lamb (2009) acknowledge that few climate measures use students as a source of feedback but believes each student's perspective is critical, particularly during transitions from one school level to the next. Given the importance of this feedback, Freiberg argues that using measures that assess student perceptions and worries about school should be part of all school reform efforts. A case is also made for the importance of caring to positive development. For example, Elias et al.

(1997) researched more than a decade ago the role of caring and stated that they believe that caring is central to the shaping of meaningful, supportive, rewarding, and productive relationships. Caring occurs when children believe that adults unconditionally accept and respect them, and the community believes everyone is important and has something to contribute. But can the importance of caring be acknowledged as a critical part of the current reform agenda?

Parker Palmer has been instrumental in calling our attention to the learning needs of teachers as learners. He argued (Palmer, 1999) more than a decade ago that we need to acknowledge that teaching and learning not only involve intellect and emotion, but also involve the human spirit. He underscores the point that teaching and learning are not either/or in the sense of being intellectual or spiritual. He contends that teachers—regardless of their subject matter and who their students are—end up teaching *who* they are. The biggest challenge is to provide teachers with adequate time and support to reflect on questions worth living. Time for self-reflection can renew and transform practices and ways of relating to self and others. Teachers need opportunities to learn and change their minds.

To accomplish trusting relationships among and between teachers and students and family members, strategies for promoting school cultures of caring need to be implemented gradually and be guided by student and family voices (Schaps & Lewis, 1999). Earlier research by Battistich, Soloman, Watson, and Schaps (1997) shows that middle school students' perceptions of "sense of school as community" were consistently associated with a positive orientation toward school and learning, including attraction to school, task orientation toward learning, educational aspirations, and trust and respect for teachers. The data also indicated that students' perceptions of community were positively associated with prosocial attitudes, social skills, and sense of autonomy and efficacy; they were negatively related to students' drug use and involvement in delinquent behavior. When these communities satisfy basic psychological needs, students become bonded to such schools and accept their values. Similar findings continue to surface with a growing understanding of the importance of the middle school years in establishing positive learning relationships and climates (e.g., Harter, 2012; Kristjansson, 2010; Lee, 2011; McCombs, 2007, 2009; Morris & Hiebert, 2011; Wentzel & Wigfield, 2009).

According to Schaps, Watson, and Lewis (1997), the structural changes necessary to create caring school cultures are relatively simple and inexpensive to bring about. The larger issue is to achieve a fundamental attitude shift among educators, policymakers, and the public. They must be convinced that in addition to responding to pressure to produce high test scores, it is legitimate and necessary to focus on the development of caring and competent people. School time spent developing trusting relationships, talking with students, and guiding them to be more competent across all domains of caring must also be deemed valuable.

Implications for Application in Curriculum, Instruction, and Assessment

In my earlier chapter, I cited M. Sadker and D. Sadker (1994) who stated, "Most educators regard the formal curriculum as the organization of intended outcomes for which the school says it is responsible" (p. 163). Then as now, many are arguing that the 20th-century curriculum was primarily focused on knowledge transmission (e.g., Carroll, 2000; Berry, 2011; Berryman, 1993; Shepard, 2000; Judy & D'Amico, 1998; Rosen, 2011) and the instruction practices and assessments aligned with the transmission of established knowledge in content areas. Jones (2001) points out that educational technology clearly brings to the forefront debates about education as the transmission of information versus education as learning and experience, or "formal" versus "natural" education.

Advice from Bransford (2001) continues to be needed today. He points out that being *knowledge-centered* includes looking at the world in which people will eventually operate and then designing learning opportunities by working backwards from that perspective. Carroll (2000, 2001) describes how a networked community can support three types of knowledge-centered outcomes: knowledge transmission, knowledge adaptation, and knowledge generation. Designs for knowledge-centered curricula assumes that the learners are immersed in current events that highlight topics and issues that they can learn from and contribute to through active engagement with others in the networked community who are also actively addressing the topics and issues. Educators and community members can provide leadership in terms of thinking more deeply about the knowledge and skills applicable to living and working in the 21st-century society, taking seriously questions about *what* should be taught by helping learners prioritize the focus of their learning activities (Bransford, 2001; Fullan, 2010).

There are also personal and interpersonal development features of curriculum that emerge from the social interactions among those in the networked community. An integrated focus on the personal, organizational, and community levels of learning clarifies the need for a holistic and integrated curriculum characterized by core standards for basic content knowledge and skills, for career development, and for social-emotional and physical development. Underlying this framework is the thinking of those who work with *living systems* and seek to center on human needs and natural processes that must be supported in the systems that address technical issues (curriculum, instruction, assessment) and organizational issues (management structures, decision making, policies). Thus, increased attention is needed to the research-based living systems framework and issues relevant to the personal, technical, and organizational domains of e-learning cultures and communities (see Hannum & McCombs, 2008; McCombs, 2000, 2009).

Closely intertwined with the holistic, community-based curriculum is instruction that is essentially *learner-centered*, in the sense of connecting with the knowledge, skills, attitudes, and beliefs of learners (APA, 1993, 1997; Bransford et al., 1999; McCombs, 2001, 2007, 2009; McCombs & Miller, 2007, 2009; McCombs & Whisler, 1997). McCombs (2000, 2009) points out that both students and teachers are co-learners with changing roles as the learning content, context, and community shape individual expertise in nonlinear learning approaches. As Peck explains, the notion of teacher no longer seems like the appropriate term for the leaders in these networked communities. Leaders, or "expert learners" as Carroll (2001) describes them, will need to view a large part of their responsibility as the creation of the social conditions that will promote learning.

We have seen that 21st-century instruction needs to focus on fostering self-directed learning habits along a development continuum from novice to mature learner and expert. Rose (2001) explains that development of higher-level thinking skills, or learning, which can be applied to a variety of situations, rather than just recitation of facts, happens best when the learners interact both with the information and with others to discuss their understanding. This requires an understanding that learning happens in the context of interaction with other humans. When the interactions are an important part of the learning process, then developing the learning community is important to the process (Rose, 2001).

Balancing a focus on learners with a focus on the desired academic, social, and personal knowledge domains required of responsible 21st-century learners and citizens promises to offset traditional learning system problems with learner motivation, engagement, and social development (McCombs, 2009). Instructional practices within a holistic curriculum that is knowledge-centered also involves a serious examination of how to help students learn with understanding rather than only memorization. This can help students organize their knowledge, skills and attitudes in ways that support transfer—where transfer includes the idea of "preparing people for future learning" (see Bransford & Schwartz, 1999; Levine, 2010).

A shift in assessment practices to support a learning culture was advocated by Shepard (2000) in my earlier chapter. She argued that it is essential to move the current paradigm to one that blends current ideas from cognitive, constructivist, and sociocultural theories because of the corruption of the standards movement into a heavy-handed system of rewards and punishments. Dynamic, ongoing assessments that can help determine what a student is able to do independently and with adult guidance are needed to guide optimal development. By placing learners in communities of practice, individuals can become increasing adept and competent while developing robust understandings of concepts. Good assessments, Shepard argued, are those that help students rethink old understandings, draw new connections, and create new applications. Self-assessments that help students monitor their own progress also helps them share responsibility for learning with teachers while developing increased ownership of their own learning. The evaluation of teaching should include helping teachers make their own investigations and reflections visible to students as part of the teaching and learning dialogue. For these changes to occur, however, teacher development must include an understanding of motivation and how to develop classroom cultures where learning and learners are at the center. Attention must also be focused on helping teachers reflect on their beliefs and undergo a personal change process. Armed with a clear understanding of their understanding of learning principles, combined with developmental and individual differences influences, teachers are have the competencies and skills to take on the new leadership roles that can guide curriculum, instruction, and assessment decisions in their local contexts.

Implications for Application in New Learning Communities and Cultures

Honey (2001) addressed the unrealized promise of emerging technologies to create new types of learning communities and cultures. Although technologies can provide powerful scaffolds to complex processes like inquiry and computational reasoning and the interpretation media artifacts, she pointed out that we also know that school organizations are powerful mediators and frequently powerful resisters of learning innovations. Honey reported that when student learning does improve in schools that become technology-rich, those gains are not caused solely by the presence of technology or by isolated technology-learner interactions. Rather, she said such changes are grounded in learning environments that prioritize and focus on *core educational objectives* at the organizational level—advice that is being echoed today as it was a decade ago (e.g., Berry, 2011; Buffum et al., 2010; Buziak & Laitusis, 2010; R. Caine & G. Caine, 2011; Hawkins, Spielvogel, & Panush, 1997; Chang et al., 1998; Haas & Fischman, 2010; Honey, Hawkins, & Carrigg, 1998, Center for Children and Technology, 2000; Lee & Shute, 2010; Richardson, 2006; Roblyer, 2006; Rosen, 2011; Wai et al., 2010).

Issues outlined by Witherspoon (2001), for which educational psychology's knowledge base could be helpful in designing effective learning communities and cultures, remain true today. These issues center on ethical governance practices that are relevant to both on- and off-line applications. They include:

- Designing "civil interchange" into system functions and promoting intercultural sensitivity.
- Developing rigorous standards to protect and enforce the privacy of participants, to assure the identity of students taking tests, to determine that inquiries for student-related information come from those authorized to have that information.
- Providing accessibility of communities and programs to those with disabilities as well as to those in poverty areas.

In my prior chapter I cited work by Wilhelm (2001) who raised another organizational issue associated with networked learning, the central issue of equity. In terms of achieving greater equality in students' opportunity to learn, technological innovation often drives a deeper wedge between the haves and have-nots. Thus less affluent districts are often playing catch up to cohorts with higher per-pupil expenditures. While acknowledging the digital divide, a decade ago Peck (2001) contended that if the student-to-student interactions were expanded and electronic support was provided to scaffold students in the process of providing feedback to each other, the costs of e-learning could be dramatically reduced, making it accessible to everyone possessing the necessary learning to learn skills. This is being born out today (e.g., Jukes et al., 2011) as emerging learning principles and technologies begin to permeate today's educational landscape and students are the focal point of personalized learning experiences. More and more schools are using smart teaching boards, students are allowed to bring in their laptops of iPads, and districts are investing in various ways to bring outdated classrooms up to 21st-century standards.

My colleagues and I (cf. Hannum & McCombs, 2008) identified the following characteristics associated with distance learning that is more learner-centered:

- Practices integrate learning and motivational strategies to help students become self-directed learners.
- Instruction includes preassessments as well as ongoing assessments of students' interests, goals, background knowledge, and needs to better tailor practices to each individual and to better connect other learners in learning communities and/or communities of practice.
- Students are involved in co-creating instruction and all instructional experiences with their "teachers" and others in their learning communities.
- Practices address both community and individual personal needs.
- Curriculum is customized based on preassessment and ongoing assessment data.
- Curriculum is flexible and dynamic, with a minimum of structure, and that structure is based on student needs and/or developmental considerations.
- Concepts of "emergent" curricula allow individual learners and the community of learners to evolve and create curricula that includes dynamic and up-to-date information based on their needs.
- Curriculum goals are negotiated among all learners in the community.
- Curricula dynamically change with each new group of students, based on their needs, interests, goals, backgrounds, and so on.
- Curricula accommodate teachers as learners and learners as teachers.
- Student-designed assessment and feedback loops are present at the individual and group levels; these are co-created with teachers, parents, and other stakeholders.
- Feedback is available for student review "on call" for self-evaluation of progress.
- Feedback is available for others to see when students are "ready" to submit work.
- Feedback provides ways for students to remediate and enrich their knowledge and skills in areas of choice as appropriate.
- Flexibility and adaptability are central design features.

We believe that in the context of distance learning, the learner-centered perspective contributes a balanced focus on the individual learner (the changing role of that learner from novice to expert, from learner to teacher), the learning process (the dynamic, self-directed, and often social nature of that process), and the learning context (the environment, climate, and community that supports the learner and the learning process). This balance is essential within the learner-centered framework. We also believe that the key issues in using distance learning to support learner-centered principles and practices are to: (a) build ways to meet learner needs for interpersonal relationships and connections; (b) find strategies that respond to individual differences and the diversity of learner needs, abilities, and interests; (c) tailor strategies to differing learner needs for personal control and choice; and (d) assess the efficacy of technology to meet diverse and emerging individual learner and learning community needs.

We also believe that the key issues in using distance learning to support learner-centered principles and practices are:

- Building ways to meet learner needs for interpersonal relationships and connections.
- Finding strategies that respond to individual differences and the diversity of learner needs, abilities, and interests.
- Tailoring strategies to differing learner needs for personal control and choice.
- Assessing the efficacy of technology to meet diverse and emerging individual learner and learning community needs.

Each of these issues may present a greater challenge in a distance and other e-learning environments as a result of the physical separation of learners from teachers. Technology can change the role of teachers to that of co-learners and contributors to the social and interpersonal development of students, counterbalancing the potential of computer technology to lead to personal and social isolation and alienation (Wallace, 1999). Technology can further promote student connections to the community around them and to working in groups on real-world projects across time and space. Online delivery of education can then provide a means to centralize course development so that it achieves necessary economies of scale while linking intergenerational learners, teachers, and facilitators on a global scale. Rigorous research in all these areas is beginning to emerge (e.g., Allen & Seaman, 2007; Duffy & Kirkley, 2004; Penuel & Riel, 2007) but more research needs to be done to systematically address the above issues and the critical features needed for effective distance learning.

WHAT POLICY ISSUES ARE IMPLIED FROM THE APPLICATION OF EDUCATIONAL PSYCHOLOGY'S KNOWLEDGE BASE IN 21ST-CENTURY REFORM EFFORTS?

This final section integrates prior sections by summarizing major future issues likely to be faced by educational psychology, including political realities and the role of educational psychologists in educating the public about its knowledge base and how it can best be used in transformative ways to create the most effective teaching and learning environments for all learners in the 21st century. Major changes are highlighted in how education is viewed, its purpose, and its structures as we enter into a century with more opportunities for the use of emerging technologies for education. Policy issues that surfaced in *Handbook* chapters are discussed along with others from my own work in school reform.

Policy Issues Related to Definitions of Intelligence and Ability

Without rethinking definitions of intelligence and ability, Sternberg (this volume) argues that societal inventions may play more of a role in sorting than nature because they place high value on test scores for sorting and placement decisions. This can lead to disenfranchisement and the narrowing of skills valued, not to mention disregarding the value of creative and practical skills. Because of links to power structures, such social systems tend to perpetuate themselves and become "endlessly looping" closed systems. Policies thus need to emphasize multiple measures and reexamination of selection and placement criteria.

In general, policies are needed that recognize the growing knowledge base on alternative conceptions of intelligence and ability. These policies must emphasize the valuing of diversity and pluralism at all levels of the educational system. They must embrace Banks' (2000) plea for new conceptions of race and ethnicity, intellectual ability, and knowledge systems, such that these conceptions do not privilege particular racial, ethnic, social class, or gender group; that is, new conceptions are needed that reflect the experiences of all groups. They must also embrace new notions about learning and learners that unite rather than divide people and groups, derived from research-validated principles such as those defined in the

APA Learner-Centered Psychological Principles (1997) and recently recognized as making a big difference in student learning outcomes (Cornelius-White, 2007).

Policy Issues Related to New Teacher and Student Roles in Teaching, Learning, and Assessment

The spirit of vitality in learner-centered schools is that aspect of the culture committed to learning and change. Teachers' needs to be learners must be part of the culture that supports student motivation, learning, and achievement. The nature of the culture formed among teachers committed to high achievement for all learners is one that is also committed to ongoing learning, change, and improvement. The process must be one that supports continuous examination and critical inquiry into ways of helping students learn better must become a normal activity that involves the whole faculty and builds community. The vision is subject to change, and the whole system maintains flexibility and openness to new learning, transformation, and change.

Policies are needed that provide for flexibility in programs that support learning and change for all learners, including teachers and other adults. Roles must be subject to change and "one size fits all" thinking must be eliminated. Allowing students to become teachers, listening to and respecting the perspectives of all learners must be part of the culture and embedded in policies that govern school functioning.

Policy Issues Related to Individualization of Learning Content and Experiences

Integrated instructional programs must themselves be a model of the very process and quality they want to engender in teachers as learners. To produce quality teaching and learning, learners must experience both quality content and processes. Systems that foster quality by fear-based or punitive measures engender fear, withdrawal, and half-hearted compliance. Unfortunately, this is coloring much of today's reform agenda. Principles of respect, fairness, autonomy, intellectual challenge, social support, and security must guide the standard-setting and implementation process. Time for learning and change, to share successful practices, experiment, and continually improve must be acknowledged.

Policies to deal with these issues must be guided by an understanding of schools as living systems as well as an understanding of individual, organizational, and community learning needs. Punitive and coercive practices should be avoided and collaborative and inclusive practices encouraged. Trust building and relationship building through dialogue need to be explicitly acknowledged in federal, state, and local school policies.

Policy Issues Related to Content and Curriculum That Meets Whole Learner Needs

From a broad systems view, many educators, researchers, and policy makers are agreed that the current educational, judicial, and social systems are not working (e.g., Nissen, 1999; Norris, 1999; Wheatley, 1999, 2010). They see them as not only unconnected but based on outdated thinking and old models of human learning, growth, and development. Further, these current systems are often based on principles applicable to nonliving, mechanical systems and do not match the uncertainty and complexity of living, human systems. Thus, it is time to explore a new model that includes what is needed in living systems to bring the system into balance. It is time to support a cycle of positive teacher and youth development and learning.

When successful school reform efforts are analyzed (e.g., Fullan, 1997, 2010), the critical difference is in *how* these practices are implemented and in whether there is explicit and shared attention given to individual learners and their unique cognitive as well as social and emotional learning needs. The critical difference is in whether they are learner-centered and focus on the people and the personal domain. But this focus is balanced with challenging academic content and standards and attention to social and emotional development.

Policies are thus needed that address this balance through integrative curricula, multiple assessment measures, and a focus on school climate. Practices that encourage student responsibility for academic and nonacademic outcomes and provide them with choice and control should be explicitly addressed in policies.

Policy Issues Related to Diversity and Inclusion of All Learners

Healthy learning communities have the further defining qualities of acceptance of, room for, and honoring of all diverse views. Individuals welcome divergent perspectives because they understand that the underlying outcome is learning and change in a context of respect and caring. Individuals also understand that learning communities broaden their perspectives to make room for the learning that can occur to encompass all points of view without making anyone wrong. When different worldviews and beliefs are held, inclusive dialogue becomes the process for learning; relationships become the vehicle for change in beliefs and assumptions about learning, learners, and teaching. Self-organizing learning communities then meet individual needs for safety, and they encourage new relationships and ways of generating new relationships. Each learner's perspective is a valued medium of learning and a catalyst for change and improvement (Wheatley & Frieze, 2011).

Policies must acknowledge the relational aspects of learning and the value of each person in the system. Practices that exclude individuals—whether they be students, teachers, parents, or others that have a stake in the educational system—must be avoided. Policies must acknowledge the knowledge base on effective communication and organizational development in outlining guidelines for dealing with diversity and inclusion.

Policy Issues Related to Testing and Accountability

Practices such as grading of schools, teachers, and administrators based on the quality of student achievement can misplace the responsibility for learning (cf. McCombs, 2000). Even if teachers are held responsible for student learning, *it is the student who makes the decision to learn*. Teachers *cannot make learning happen*; they can encourage with a variety of incentives, but teachers know well that many incentives (e.g., grades, fear of discipline) work only for some students. When teachers overly control the learning process, they may get compliance, but they will not get responsibility.

Responsibility begins with making choices. Without the opportunity to choose and face the consequences of those decisions, there is no sense of ownership. Ownership, resulting from choices, is empowering. Without empowerment and ownership there is no responsibility or accountability—there is blaming and compliance. With ownership, learning is fun and exciting for students and teachers, and both share in the pleasures and responsibilities of control. When responsibility and power are shared, the natural response is empowerment, ownership, and responsibility. *We own what we create*—an important implication of the learner-centered principles and framework when applied to policy recommendations.

To *summarize*, the following are what I see as specific policy recommendations that can further the application of educational psychology's knowledge base to school reform:

- Policies must capture individual and organizational purposes directed at continuous change and learning as a holistic process that involves intellect, emotion, and spirit.
- Policies must emphasize new leadership roles that empower teachers and students alike to take increased control over their own learning and development.
- Policies must emphasize a balance between concerns with high achievement and concerns with meeting individual learning, motivational, and social needs of diverse students.
- Policies must emphasize change strategies focused on inclusive dialogue, building respectful relationships, and practices that are owned by all participants.
- Policies must value outcomes that go beyond academic achievement to emotional and social outcomes that include increased personal and social responsibility.

CONCLUSIONS

A major conclusion is that educational psychologists have a responsibility that many are increasingly recognizing and acting on—the responsibility to educate policy makers, parents, and the public about what we know that can create both effective educational experiences and a positive change or educational reform process. Not only do we need to help others understand new conceptions of learning, motivation, and development, but we also need to help them understand that learning and change are flip sides of the same social-psychological process—the process of changing one's mind. Processes and contexts that support learning are also those that support change. Change, like learning, is an ongoing, dynamic, and lifelong process of continuous improvement. It can be motivating, invigorating, and challenging, or it can be fearful, intimidating, and punitive.

As we embark on a new decade of school reform, educational psychology promises to provide more insights into not only how to enhance individual learning, motivation, and development. It also promises to assist in understanding the conditions, contexts, and processes for effective change and educational reform. This is a challenge I believe the field is ready to accept. Based on the contributions to educational psychology in this volume and in the field in general, this is also a challenge on which I believe we are prepared and ready to deliver. I leave you with a personal challenge and an opportunity to help change the future preparation of researchers and educators: Will you join me and a growing host of other national and international researchers and practitioners in creating the vision we need based on the timeless truths that have been continually re-validated? Will we get this moving train headed in the right direction? I hope and believe so.

REFERENCES

Ackerman, G. L. (2010). Bridging 21st century gaps: An essay review of Mehlenbacher's Technology and Instruction. *Education Review, 14*(3). www.edrev.info/essays/v14n3.pdf

Allen, I., & Seaman, J. (2007). *Online nation: Five years of growth in online learning*. Needham, MA: Sloan.

APA Task Force on Psychology in Education (1993, January). Learner-centered psychological principles: Guidelines for school redesign and reform. Washington, DC: American Psychological Association and Mid-Continent Regional Educational Laboratory.

APA Work Group of the Board of Educational Affairs (1997, November). *Learner-centered psychological principles: A framework for school reform and redesign.* Washington, DC: American Psychological Association.

Archambault, I., Eccles, J. S., & Vida, N. M. (2010). Ability self-concepts and subjective value in literacy: Joint trajectories from grades 1 through 12. *Journal of Educational Psychology, 102*(4), 804–816.

Banks, J. A. (2000). The social construction of difference and the quest for educational equality (pp. 21–45). In R. S. Bandt (Ed.), *Education in a new era*. Alexandria, VA: Association for Supervision and Curriculum Development.

Battistich, V., Soloman, D., Watson, M., & Schaps, E. (1997). Caring school communities, *Educational Psychologist, 32*(3), 137–151.

Becker, M., McElvany, N., & Kortenbruck, M. (2010. Intrinsic and extrinsic reading motivation as a predictor of reading literacy: A longitudinal study. *Journal of Educational Psychology, 102*(4), 773–785.

Berreth, D., & Berman, S. (1997). The moral dimensions of schools. *Educational Leadership, 54*(8), 24–27.

Berry, B. (2011). Teacherpreneurs: A more powerful vision for the teaching profession. *Kappan, 92*(6), 28–33.

Berryman, S. E. (1993). Learning for the workplace. *Review of Research in Education, 19*, 343–401.

Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W., & Soloway, E. (2000). Creating usable innovations in systemic reform: Scaling up technology-embedded project-based science in urban schools. *Educational Psychologist*, *35*(3), 149–164.

Bollier, D. (2000). *Ecologies of innovation: The role of information and communications technologies.* Washington, DC: Aspen Institute.

Borko, H., Peressini, D., Romagnano, L., Knuth, E., Willis-Yorker, C., Wooley, C., . . . Masarik, K. (2000). Teacher education does matter: A situative view of learning to teach secondary mathematics. *Educational Psychologist, 35*(3), 193–206.

Boyer, E. L. (1995). *The basic school: A community for learning*. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Bransford, J. (2001). *Toward the development of a stronger community of educators: New opportunities made possible by integrating the learning sciences and technology.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Bransford, J., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bransford, J. D., & Schwartz, D. (1999). Rethinking transfer: A simple proposal with multiple implications. *Review of Research in Education, 24,* 61–100.

Braun, H. (2001). *PT3: Assessment and evaluation*. Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Broadfoot, T. (2001). *Assessment for an uncertain age*. Presentation on April 22, 2001, at the Cultures of Learning Conference, Session 3.32, sponsored by the University of Bristol, Bristol, England.

Buffum, A., Mattos, M., & Weber, C. (2010). The why behind TRI: Response to Intervention flourishes when educators implement the right practices for the right reasons. *Educational Leadership, 68*(2), 10–16.

Buziak, H. M., & Laitusis, C. C. (2010). Using growth for accountability measurement challenges for students with disabilities and recommendations for research. *Educational Researcher, 39*(7), 537–544.

Caine, R. (2008). How neuroscience informs our teaching of elementary students. *Comprehension Instruction* (2nd ed.). New York, NY: Guilford Press.

Caine, R. N., & Caine, G. (1994). *Making connections: Teaching and the human brain.* Menlo Park, CA: Addison - Wesley.

Caine, R. N., & Caine, G. (2011). *Natural learning for a connected world: Education, technology, and the human brain.* New York, NY: Teachers College Press.

Campitelli, G., & Gobet, F. (2010). Herbert Simon's decision - making approach: Investigation of cognitive processes in experts. *Review of General Psychology, 14*(4), 354–364.

Carroll, T. G. (2000, March). *Thinking outside the box about technology evaluation*. Keynote presentation at the North Central Regional Educational Laboratory's Regional Conferences on Evaluating Technology in Education. Chicago, IL; Denver, CO; and Atlanta, GA.

Carroll, T. G. (2001). *Do today's evaluations meet the needs of tomorrow's networked learning communities?* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Ceci, S. J., & Papierno, P. B. (2005). The rhetoric and reality of gap closing: When the "have-nots" gain but the "haves" gain even more. *American Psychologist, 60*(2), 149–160.

Center for Children and Technology. (2000). *The Transformation of Union City: 1989 to Present.* Technical Report. New York, NY: EDC/Center for Children and Technology.

Chamberlin, J. (2011). Why can't some children manage stress? *Monitor on Psychology, 42*(2), 77.

Chang, H., Henriquez, A., Honey, M., Light, D., Moeller, B., & Ross, N. (1998). *The Union City story: Education reform and technology—Students' performance on standardized tests.* Technical report. EDC/Center for Children and Technology.

Church, M. A., Elliot, A. J., & Gable, S. L. (2001). Perceptions of classroom environment, achievement goals, and achievement outcomes. *Journal of Educational Psychology, 93*(1), 43–54.

Clay, R. A. (2010). More than one way to measure. *Monitor on Psychology, 41*(10), 52–55.

Clem, F., & Simpson, E. (2007). Viewpoint. Meeting students where they can learn and have a profound effect on education. *eSchool News, 10*(2), 27.

Cohen, D., & Barnes, C. (1999). Research and the purposes of education. In Lagemann, E. & Shulman, L. (Ed.). *Issues in education research*. San Francisco, CA: Jossey-Bass.

Cohen, D. K., & Ball, D. L. (2001). Making change: Instruction and its improvement. *Phi Delta Kappan, 83*(1), 73–77.

Confrey, J., & Sabelli, N. (2001). *Research and evaluation in and on "Preparing Tomorrow's Teachers for Technology."* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Corcoran, T., Fuhrman, S. H., & Belcher, C. L. (2001). The district role in instructional improvement. *Phi Delta Kappan, 83*(1), 78–84.

Cornelius-White, J. (2007). Learner-centered teacher-student relationships are effective: A meta-analysis. *Review of Educational Research, 77*(1), 113–143.

Csikszentmihalyi, M. (2003). Legs or wings? A reply to R. S.Lazarus. *Psychological Inquiry, 14,* 113–115.

Darling-Hammond, L. (1996). The quiet revolution: Rethinking teacher development. *Educational Leadership, 53*(6), 4–10.

Darling-Hammond, L. (2010). Teacher education and the American future. *Journal of Teacher Education, 61*(1–2), 35–47.

Deakin-Crick, R., McCombs, B., Haddon, A., Broadfoot, P., & Tew, M. (2007). The ecology of learning: Factors contributing to learner-centred classroom cultures. *Research Papers in Education, 22*(3), 267–307.

Deangelis, T. (2010). Getting research into the real world. *Monitor on Psychology, 41*(10), 60–65.

deCharms, R. (1968). Personal causation: The internal affective determinants of behavior. New York, NY: Academic Press.

Deci, E. L., & Ryan, R. M., (1985). Intrinsic motivation and self determination in human behavior. New York, NY: Academic Press.

Dede, C. (October, 13, 2000). *Expert panel on technology and educational reform*. Panel presentation at the North Central Regional Educational Laboratory First Annual Conference.

Dede, C. (2009). Technologies that facilitate generating knowledge and possibly wisdom. *Educational Researcher, 38*(4), 260–263.

Dewey, J. (1990). *The school and society and the child and the curriculum*. Chicago, IL and London, UK: University of Chicago Press.

Diamond, M., & Hopson, J. (1998). *Magic trees of the mind*. New York, NY: Dutton.

Duchesne, S., & Ratelle, C. (2010). Parental behavior and adolescents' achievement goals at the beginning of middle school: Emotional problems as potential mediators. *Journal of Educational Psychology, 102*(2), 497–507.

Duffy, T. M., & Kirkley, J. R. (2004). *Learner-centered theory and practice in distance education*. Mahwah, NJ: Erlbaum.

Eagley, A. H., & Chin, J. L. (2010). Are memberships in race, ethnicity, and gender categories merely surface characteristics? *American Psychologist, 65*(9), 934–935.

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist, 46*(1), 6–25. doi:10.1080/00461520.2011.538645

Elias, M. J., Bruene-Butler, L., Blum, L., & Schuyler, T. (1997). How to launch a social and emotional learning program. *Educational Leadership, 54*(8), 15–19.

Elias, M. J., Zins, J. E., Weissberg, R. P., Frey, K., Greenberg, M. T., Haynes, N. M., . . . Shriver, T. P. (1997). *Promoting social and emotional learning: Guidelines for educators.* Alexandria, VA: Association for Supervision and Curriculum Development.

Elmore, R. F., & Fuhrman, S. H. (2001). Holding schools accountable: Is it working? *Phi Delta Kappan, 83*(1), 67–72.

English-Lueck, J.A. (June 19, 1998). *Technology and social change: The effects on family and community*. COSSA Congressional Seminar Report. www.sjsu.edu/depts/anthropology/svcp/SVCPcosa.html

Feuerstein, R. & Feuerstein, S. (1991). Mediated learning experience: A theoretical review. In R. Feuerstein, P. S. Klein, & A. J. Tannenbaum (Eds.), *Mediated learning experience: Theoretical, psychosocial and learning implications* (pp. 3–51). London, UK: Freund.

Floresco, S. B. (2011, April). Neural circuits underlying behavioral flexibility: Multiple brain regions work together to adapt behavior to a changing environment. *APA Science Briefs: Psychological Science Agenda.* www.apa.org/science/about/psa/2011/04/neural-circuits.aspx

Flowerday, T., & Schraw, G. (2000). Teacher beliefs about instructional choice: A phenomenological study. *Journal of Educational Psychology, 92*(4), 634–645.

Freiberg, H. J. (1998). Measuring school climate: Let me count the ways. *Educational Leadership, 56*(1), 22–26.

Freiberg, H. J., & Lamb, S. M. (2009). Dimensions of person-centered classroom management. *Theory into Practice, 48*(2), 99–105.

Fuhrman, S. H., & Odden, A. (2001). Introduction to a Kappan special section on school reform. *Phi Delta Kappan, 83*(1), 59–61.

Fullan, M. (1997). Emotion and hope: Constructive concepts for complex times. In A. Hargreaves (Ed.), *Rethinking educational change with heart and mind.* Alexandria, VA: 1997 ASCD Yearbook, pp. 216–223.

Fullan, M. (2010). The big ideas beyond whole system reform. *Education Canada*. www.michaelfullan.ca/Articles_10/BigIdeas-CEA.pdf

Fullan, M. G. (1995). The limits and the potential of professional development. In T. R. Guskey & M. Huberman (Eds.), *Professional development in education: New paradigms and practices* (pp. 253–267). New York, NY: Teachers College Press.

Gipps, C. (2001). *Sociocultural perspectives on assessment*. Presentation on April 22, 2001, at the Cultures of Learning Conference, Session 3.32, sponsored by the University of Bristol, Bristol, England.

Goddard, R. D., Hoy, W. K., & Hoy, A. W. (2000). Collective teacher efficacy: Its meaning, measure, and impact on student achievement. *American Educational Research Journal, 37*(2), 479–507.

Goertz, M. E. (2001). Redefining government roles in an era of standards-based reform. *Phi Delta Kappan, 83*(1), 62–66.

Goldschmidt, P., & Wang, J. (1999). When can schools affect dropout behavior? A longitudinal multilevel analysis. *American Educational Research Journal, 36*(4), 715–738.

Goleman, D. (1995). *Emotional intelligence.* New York, NY: Bantam Books.

Goleman, D., Boyatzis, R., & McKee, A. (2002). *Primal leadership: Realizing the power of emotional intelligence*. Boston, MA: Harvard University Press.

Gottfried, A. E., Fleming, J. S., & Gottfried, A. W. (2001). Continuity of academic intrinsic motivation from childhood through late adolescence: A longitudinal study. *Journal of Educational Psychology, 93*(1), 3–13.

Green, J. A., Torney-Purta, J., & Azevedo, R. (2010). Empirical evidence regarding relations among a model of epistemic and ontological cognition, academic performance, and educational level. *Journal of Educational Psychology, 102*(1), 234–255.

Greene, J. A., & Azevedo, R. (2010). The measurement of learners' self-regulated cognitive and metacognitive processes while using computer-based learning environments. *Educational Psychologist, 45*(4), 203–209.

Gregory, A., Cornell, D., Fan, X., Sheras, P., Shih, T-H., & Huang, F. (2010). Authoritative school discipline: High school practices Associated with lower bullying and victimization. *Journal of Educational Psychology, 102*(2), 483–496.

Groff, W. (2001). *Career development paradigms for digital dividends.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Haas, E., & Fischman, G. (2010). Nostalgia, entrepreneurship, and redemption: Understanding prototypes in higher education. *American Educational Research Journal, 47*(3), 532–562.

Hannafin, M. (1999). *Learning in open-ended environments: Tools and technologies for the next millennium.* (ITFORUM Paper 34) Downloaded from http://itech1.coe.uga.edu/itforum/paper34/paper34.html

Hannum, W. H., & McCombs, B. L. (2008). Enhancing distance learning for today's youth with Learner-Centered Principles. *Educational Technology, 48*(3), 11–21.

Harter, S. (2012). The construction of the self: Developmental and sociocultural foundations. New York, NY: Guilford Press.

Hawkins, J. Spielvogel, R., & Panush, E. (1997). *National study tour of district technology integration summary report.* Technical report. New York, NY: EDC/Center for Children and Technology.

Heflich, D. (2001). *Breaching the walls of a cell: changes brought about by electronic networking.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Hidi, S., & Harackiewicz, J. M. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research, 70*(2), 151–179.

Honey, M. (2001). *Issues in using technology to support local school-change.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Honey, M., Hawkins, J., & Carrigg, F. (1998). Union City online: An architecture for networking and reform. In C. Dede (Ed.), *The 1998 ASCD yearbook: Learning with technology.* Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Hoy, A. W. (2000). Educational psychology in teacher education. *Educational Psychologist, 35*(4), 257–270.

Huang, C. (2010). Mean-level change in self-esteem from childhood through adulthood: Meta-analysis of longitudinal studies. *Journal of General Psychology, 14*(3), 251–260.

Jensen, E. (1998). *Teaching with the brain in mind.* Alexandria, VA: Association for Supervision and Curriculum Development.

Jones, S. (2001). *Community and culture in education.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Joseph, R., & Reigeluth, C.M. (2005). Formative research on an early stage of the systemic change process in a small school district. *British Journal of Educational Technology, 36*(6), 937–956.

Judy, R. W., & D'Amico, C. (1998). *Workforce 2020: Work and workers in the 21st century*. Indianapolis, IN: Hudson Institute.

Jukes, I., McCain, T., & Crockett, L. (2011). Education and the role of the future educator in the future. *Kappan, 92*(4), 15–21.

Kirst, M., & Venezia, A. (2001). Bridging the great divide between secondary schools and postsecondary education. *Phi Delta Kappan, 83*(1), 92–97.

Klein, J., & Cornell, D. (2010). Is the link between large high schools and student victimization an illusion? *Journal of Educational Psychology, 102*(4), 933–946.

Klein, K. M., & Wang, M. (2010). Deep-level diversity and leadership. *American Psychologist, 65*(9), 932–933.

Kogan, M. (2000). Teaching truth, beauty, and goodness: An interview with Howard Gardner. *Monitor on Psychology, 31*(11), 66–67.

Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukopadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being? *American Psychologist, 53,* 1017–1031.

Kristjansson, K. (2010). Positive psychology, happiness, and virtue: The troublesome conceptual issues. *Review of General Psychology, 14*(4), 296–310.

Lambert, N. M., & McCombs, B. L. (Eds.). (1998). How students learn: reforming schools through learner-centered education (1st ed.). Washington, DC: American Psychological Association.

Lazarus, R. S. (2000). Toward better research on stress and coping. *American Psychologist, 55*(6), 665–673.

Lazarus, R. S. (2003). Does the positive psychology movement have legs? *Psychological Inquiry, 14,* 93–109.

Lee, C. D. (2011). Soaring above the clouds, delving the ocean's depths: Understanding the ecologies of human learning and the challenge for education science. *Educational Researcher, 39*(9), 643–655.

Lee, J., & Shute, V. J. (2010). Personal and social-contextual factors in K-12 academic performance: An integrative perspective on student learning. *Educational Psychologist, 45*(3), 185–202.

Lee, V. E., & Smith, J. B. (1999). Social support and achievement for young adolescents in Chicago: The role of school academic press. *American Educational Research Journal, 36*(4), 907–945.

Legault, L., Green-Demers, I., & Pelletier, L. (2006). Why do high school students lack motivation in the classroom? Towards an understanding of academic amotivation and the role of social support. *Journal of Educational Psychology, 98*(3), 567–582.

Levine, A. (2010). Teacher education must respond to changes in America. *Kappan, 92*(2), 19–24.

Ley, K., & Young, D. B. (2001). Instructional principles for self-regulation. *Educational Technology Research and Development, 49*(2) 93–103.

Libbey, H. P. (2004). Measuring student relationships to school: Attachment, bonding, connectedness, and engagement. *Journal of School health, 74*(7), 274–283.

Lin, X. (2001). Designing metacognitive activities. *Educational Technology Research and Development, 49*(1), 23–40.

Lopez, S. J. (2010). Making ripples: How principals and teachers can spread hooe throughout our schools. *Kappan, 92*(2), 40–44.

Loughran, J. (1996). *Developing reflective practice: Learning about teaching and learning through modeling*. London, UK: Falmer Press.

Malmberg, L. E., Hagger, H., Burn, K., Mutton, T., & Colls, H. (2010). Observed classroom quality during teacher education and two years of professional practice. *Journal of Educational Psychology, 102*(4), 916–932.

Marx, R. W. (2000). School reform and research in educational psychology. *Educational Psychologist, 35*(3), 147–148.

Marzano, R. (2005). *What works in schools*. Alexandria, VA: ASCD.

McCombs, B. L. (1997). Self-assessment and reflection: Tools for promoting teacher changes toward learner-centered practices. *NASSP Bulletin, 81*(587), 1–14.

McCombs, B. L. (2000a). Reducing the achievement gap. *Society, 37*(5), 29–36.

McCombs, B. L. (2000b). *Addressing the personal domain: The need for a learner-centered framework.* Paper presented in the symposium, "Learner-Centered Principles in Practice: Addressing the Personal Domain," at the annual meeting of the American Psychological Association, Washington, DC.

McCombs, B. L. (2000c). *Addressing the role of educational technology in the teaching and learning process: A learner-centered perspective*. Invited white paper for the Secretary's Conference on Educational Technology, September 11–12, 2000, Alexandria, VA.

McCombs, B. L. (2001). *The learner-centered perspective on teaching and learning in electronically networked cultures.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

McCombs, B. L. (2003). What really happens in school reform in the new economy: It's more than simply changing classes. Review of "Changing Classes" by Martin Packer. *Contemporary Psychology, 48*(6), 796–800.

McCombs, B. L. (2004). The learner-centered psychological principles: A framework for balancing a focus on academic achievement with a focus on social and emotional learning needs (pp. 23–39). In J. E. Zins, R. P. Weissberg, M. C. Wang, & H. J. Walberg (Eds.), *Building academic success on social and emotional learning: What does the research say?* New York, NY: Teachers College Press.

McCombs, B. L. (2007). Balancing accountability demands with research-validated, learner-centered teaching and learning practices (pp. 41–60). In C. E. Sleeter (Ed.), *Educating for democracy and equity in an era of accountability.* New York, NY: Teachers College Press.

McCombs, B. L. (2009). Commentary: What can we learn from a synthesis of research on teaching, learning, and motivation? (pp. 655–670). In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school*. New York, NY: Routledge.

McCombs, B. L. (in press, a). Self-regulated learning and academic achievement: A phenomenological view. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, Research, and Practice* (2nd ed.). Mahwah, NJ: Erlbaum.

McCombs, B. L. (in press, b). The learner-centered psychological principles: A framework for balancing a focus on academic achievement with a focus on social and emotional learning needs. In J. E. Zins, R. P. Weissberg, M. C. Wang, & H. J. Walberg (Eds.), *Building school success on social and emotional learning.* New York, NY: Teachers College Press.

McCombs, B. L., & Lauer, P. A. (1997). Development and validation of the learner-centered battery: Self-Assessment tools for teacher reflection and professional development. *The Professional Educator, 20*(1), 1–21.

McCombs, B. L., & Lauer, P. A., & Pierce, J. (1998, July). *The learner-centered model of seamless professional development: Implications for practice and policy changes in higher education*. Paper presented at the 23rd International conference on Improving University Teaching, Dublin, Ireland.

McCombs, B. L., & Miller, L. (2007). *Learner-centered classroom practices and assessments: Maximizing student motivation, learning, and achievement.* Thousand Oaks, CA: Corwin Press.

McCombs, B. L., & Miller, L. (2009). *The school leader's guide to learner-centered education: From complexity to simplicity.* Thousand Oaks, CA: Corwin Press.

McCombs, B., & Vakili, D. (2005) A learner-centered framework for e-learning. *Teachers College Record, 107*(8), 1582–1609.

McCombs, B. L., & Whisler, J. S. (1997). *The learner-centered classroom and school: Strategies for increasing student motivation and achievement*. San Francisco, CA: Jossey-Bass.

McLaughlin, C. (2001). *Learning-to-learn, live, and choose*. Presentation on April 22, 2001, at the Cultures of Learning Conference, Session 3.32, sponsored by the University of Bristol, Bristol, England.

McNabb, M., Hawkes, M., & Rouk, U. (1999). *Critical issues in evaluating the effectiveness of technology*. Washington, DC: U.S. Department of Education. www.ed.gov/Technology/TechConf/1999/

McNabb, M. L. (2001). *In search of strategic designs for mediating e-learning.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Meece, J. L., & Kurtz-Costes, B. (2001). Introduction: The schooling of ethnic minority children and youth. *Educational Psychologist, 36*(1), 1–7.

Meece, J. L., Herman, P., & McCombs, B. L. (2003). Relations of learner-centered teaching practices to adolescents' achievement goals. *International Journal of Educational Research, 39*, 457–475.

Meier, D. (1999). Needed: Thoughtful research for thoughtful schools. In E. Lagemann & L. Shulman (Ed.), *Issues in education research*. San Francisco, CA: Jossey-Bass.

Midgley, C., Kaplan, A., & Middleton, M. (2001). Performance approach goals: Good for whom, under what circumstances, and at what cost? *Journal of Educational Psychology, 93*(1), 77–86.

Moreno, R., & Mayer, R. E. (2000). Engaging students in active learning: The case for personalized multimedia messages. *Journal of Educational Psychology, 92*(4), 724–733.

Morris, A. K., & Hiebert, J. (2011). Creating shared instructional products: An alternative approach to improving teaching. *Educational Researcher, 40*(1), 5–14.

Nie, N.H. & Erbing, L. (2000). Internet and society: A preliminary report. Stanford Institute for the quantitative study of society. Stanford, CA: SIQSS.

Nissen, L. B. (1999, June). *The power of the strength approach.* Keynote presentation at the 8th Annual Rocky Mountain Regional Conference in Violence Prevention in Schools and Communities, Denver, CO.

Norris, T. (1999, June). *Healthy communities for healthy youth.* Keynote presentation at the 8th Annual Rocky Mountain Regional Conference in Violence Prevention in Schools and Communities, Denver, CO.

Novotney, A. (2011). Awakening the child inside. *Monitor on Psychology, 42*(1), 34–36.

Ochsner, K. N., & Lieberman, M. D. (2001). The mergence of social cognitive neuroscience. *American Psychologist, 56*(9), 717–734.

Odden, A. (2001). The new school finance. *Phi Delta Kappan, 83*(1), 85–91.

Okagaki, L. (2001). Triarchic model of minority children's school achievement. *Educational Psychologist, 36*(1), 9–20.

Orrill, C. H. (2001). Building technology-based, learner-centered classrooms: the evolution of a professional development framework. *Educational Technology Research and Development, 49*(1), 15–34.

Palmer, P. J. (1999). Evoking the spirit in public education. *Educational Leadership, 56*(4), 6–11.

Paris, S. C., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36*(2), 89–101.

Patall, E., Cooper, H., & Wynn, S. P. (2010). The effectiveness and relative importance of choice in the classroom. *Journal of Educational Psychology, 102*(4), 896–915.

Payton, J. W., Wardlaw, D. M., Graczyk, P. A., Bloodworth, M. R., Tompsett, C. J., & Weissberg, R. P. (2000). Social and emotional learning: A framework for promoting mental health and reducing risk behavior in children and youth. *Journal of School Health, 70*(5), 13–19.

Peck, K. (2001). *Electronically networked learning cultures as and within living systems.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Pekrun, R., Goetz, T., Daniels, L. M., Stupnisky, & Perry, R. P. (2010). Boredom in achievement settings: Exploring control-value antecedents and performance outcomes of a neglected emotion. *Journal of Educational Psychology, 102*(3), 531–549.

Penuel, W. R., & Riel, M. (2007). The "new" science of networks and the challenge of school change. *Phi Delta Kappan, 88*(8), 611–615.

Perry, K. E., & Weinstein, R. S. (1998). The social context of early schooling and children's school adjustment. *Educational Psychologist, 33*(4), 177–194. doi: 10.1207/s15326985ep3304_3

Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2006). Classroom assessment scoring system. Baltimore, MD: Paul H. Brookes Publishing Co., Inc.

Pink, D. H. (2009). *Drive: The surprising truth about what motivates us*. New York, NY: Riverhead Books.

Popham, W. J. (2001). *Standards-based assessment: Solution or charade*? Paper presented as part of the "Creating Classroom and Large-Scale Assessment that Enhance Instructional Decision-Making Symposium" at the Annual Meeting of the American Educational Research Association, Seattle, April 10–14, 2001.

Prensky, M. (2006). Listen to the natives. *Educational Leadership, 63*(4), 8–13.

Radel, R., Sarrazin, P., Legrain, P., & Wild, T. C. (2010). Social contagion of motivation between teacher and student: Analyzing underlying processes. *Journal of Educational Psychology, 102*(3), 577–587.

Ravitz, J. (2001). *Will technology pass the test*? Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Reigeluth, C. (2001). *High-performance high-technology learning communities: What works*? Panel presentation at the NCREL National Conference on Technology, June 8, 2001, Naperville, IL.

Reigeluth, C. M. (2005). New instructional theories and strategies for a knowledge-based society. In J. Spector, C. Ohrazda, A. Van

Schaack, & D. Wiley (Eds.), *Innovations in instructional technology: Essays in honor of M. David Merrill.* Mahwah, NJ: Erlbaum.

Repa, T. (2001). *The Internet and social and emotional learning.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Richardson, W. (2006). The new face of learning. *Edutopia, 2*(7), 34–37.

Robinson, N. M., Zigler, E., & Gallagher, J. J. (2000). Two tails of the normal curve: Similarities and differences in the study of mental retardation and giftedness. *American Psychologist, 55*(12), 1413–1424.

Roblyer, M. D. (2006). Virtually successful: Defeating the dropout problem through online school programs. *Phi Delta Kappan, 88*(1), 31–36.

Rose, R. (2001). *e-learning communities and cultures.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Rosen, L. D. (2011). Teaching the iGeneration. *Educational Leadership, 68*(5), 10–15.

Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal, 38*(2), 437–460.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78.

Sabelli, N., & Dede, C. (in press). *Integrating educational research and practice: Reconceptualizing the goals and process of research to improve educational practice*.

Sadker, M. P., & Sadker, D. M. (1994). *Teachers, schools, and society* (3rd ed.). New York, NY: McGraw-Hill.

Sampson, J. (2001). *Intelligent access and use of assessment and information resources to promote career development.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Schaps, E., & Lewis, C. (1999). Perils on an essential journey: Building school community. *Phi Delta Kappan, 81*(3), 215–218.

Schaps, E., Watson, M., & Lewis, C. (1997). A key condition for character development: Building a sense of community in school. *Social Studies Review, 37*(1), 85–90.

Scherer, M (1998). A conversation with Herb Kohl. *Educational Leadership, 56*(1), 8–13.

Schwamborn, A., Mayer, R., Thillmann, H., Leopold, C., & Lautner, D. (2010). Drawing as a generative activity and drawing as a prognostic activity. *Journal of Educational Psychology, 102*(4), 872–879.

Seligman, M. E. P., & Csikszentmihalyi. M. (2000). Positive psychology: An introduction. *American Psychologist, 55*(1), 5–14.

Shaw, S. M., Walls, S. M., Dacy, B. S., Levin, J. R., & Robinson, D. H. (2010). A follow-up note on prescriptive statements in nonintervention research studies. *Journal of Educational Psychology, 102*(4), 982–988.

Shepard, L. A. (2000). The role of assessment in a learning culture. *Educational Researcher, 29*(7), 4–14.

Shields, M. K. & Behrman, R. E. (2000, Fall/Winter). *The future of children: Children and computer technology,* (Vol. 10, no. 2, pp. 4–30). Available online at www.futureofchildren.org

Sternberg, R. J. (2011). Ethics: From thought to action. *Educational Leadership, 68*(6), 34–39.

Stewart, V. (2007). Citizens of the world. *Educational Leadership, 64*(7), 9–14.

Stiggins, R. J. (2001). *Making classroom assessment instructionally relevant*. Paper presented as part of the "Creating Classroom and Large-Scale Assessment that Enhance Instructional Decision-Making Symposium" at the Annual Meeting of the American Educational Research Association, Seattle, WA, April 10–14, 2001.

Stumbo, C., & McWalters, P. (2010). Measuring effectiveness: What will it take? *Educational Leadership, 68*(4), 10–15.

Suarez, M. M., & Sattin, C. (2007). Wanted: Global citizens. *Educational Leadership, 64*(7), 58–62.

Sun, S., & Wang, L. L. (2010). A comprehensive review of effect size reporting and interpreting practices in academic journals in education and psychology. *Journal of Educational Psychology, 102*(4), 989–1004.

Swanson, C. B. (2004). *Who graduates? Who doesn't? A statistical portrait of public high school graduation, Class of 2001*. Washington, DC: Urban Institute.

Sylwester, R. (1995). *A celebration of neurons: An educator's guide to the brain.* Alexandria, VA: Association for Supervision and Curriculum Development.

Tyack, D., & Cuban, L. (1995). *Tinkering toward utopia*. Cambridge, MA: Harvard University Press.

Van den Berg, R., & Ros, A. (1999). The permanent importance of the subjective reality of teachers during educational innovation: A concerns-based approach. *American Educational Research Journal, 36*(4), 879–906.

Van Gog, T., Van Hell, J. G., Jolles, J., de Jong, T., Manlove, S., & Van Merrienboer, J. J. G. (2011). *Explorations in learning and the brain: A quick scan of the potential of neuroscience for education.* Netherlands Organization for Scientific Research; Grant no. 411-07-991. PDF downloaded from www.Explorations%20in%20Learning%20and%20the%20Brain%20QS%20final.pdf

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wai, J., Lubinski, D., Benbow, C. P., & Steiger, J. H. (2010). Accomplishment in science, technology, engineering, and mathematics (STEM) and its relation to STEM educational dose: A 25-year longitudinal study. *Journal of Educational Psychology, 102*(4), 960–871.

Wallace, P. (1999). *The psychology of the Internet*. Cambridge, UK: Cambridge University Press.

Wallis, C., & Steptoe, S. (2006). How to bring our schools out of the 20th century. *Time, 168*(25), 50–56.

Walls, T. A., & Little, T. D. (2005). Relations among personal agency, motivation, and school adjustment in early adolescence. *Journal of Educational Psychology, 97*(1), 23–31.

Wassermann, S. (2001). Quantum theory, the uncertainty and alchemy of standardized testing. *Phi Delta Kappan, 83*(1), 28–40.

Weinberger, E., & McCombs, B. L. (2001, April). *The impact of learner-centered practices on the academic and non-academic outcomes of upper elementary and middle school students*. Paper presented in the Symposium, "Integrating What We Know About Learners and Learning: A foundation for Transforming PreK-20 Practices," at the annual meeting of the American Educational Research Association, Seattle, WA.

Wentzel, K. R., & Wigfield, A. (Eds.). (2009). *Handbook of motivation at school*. New York, NY: Routledge.

Wheatley, M. (2010). Reweaving the web of connections. Originally appeared as a blog on *Yes Magazine*'s website www.yes.org

Wheatley, M., & Frieze, D. (2011). *Walk out Walk on: A learning journey into communities daring to live the future now.* San Francisco, CA: Berrett-Koehler.

Wheatley, M. J. (1999). *Leadership and the new science: Discovering order in a chaotic world* (2nd ed.). San Francisco, CA: Berrett-Koehler.

Wheatley, M. J., & Kellner-Rogers, M. (1998). Bringing life to organizational change. *Journal of Strategic Performance Measurement,* April–May, 5–13.

Wiggins, G., & McTighe, J. (1998). Understanding by Design. Washington, DC: ERIC Clearinghouse.

Wilhelm, T. (2001). *First principles in e-learning: The "e" stands for equity*. Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Wilson, B. (2001). *Sense of community as a valued outcome for electronic courses, cohorts, and programs.* Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Winne, P. (2010). Improving measurements of self-regulated learning. *Educational Psychologist, 45*(4), 267–276.

Witherspoon, J. P. (2001). *e-learning: Ethics and governance considerations*. Paper prepared for the PT3 Vision Quest on Assessment in e-Learning Cultures. Available at www.pt3.org

Wong, C. A., & Rowley, S. J. (2001). The schooling of ethnic minority children: Commentary. *Educational Psychologist, 36*(1), 57–66.

Zech, L. K., Gause-Vega, C. L., Bray, M. H., Secules, T., & Goldman, S. R. (2000). Content-based collaborative inquiry: A professional development model for sustaining educational reform. *Educational Psychologist, 35*(3), 207–217.

Zimmerman, B. J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk, & B. J. Zimmerman (Eds.), Self-regulated learning: From teaching to self-reflective practice (pp. 1–19). New York, NY: Guilford Press.

Zimmerman, B. J., & Schunk, D. H. (Eds.). (2001). *Self-regulated learning and academic achievement: Theory, research, and practice* (2nd ed.). Mahwah, NJ: Erlbaum.

Zins, J. E., Elias, M. J., Greenberg, M. T., & Weissberg, R. P. (2000). Promoting social and emotional competence in children. In K. M. Minke & G. G. Bear (Eds.), *Preventing school problems—Promoting school success: Strategies and programs that work* (pp. 71–99). Bethesda, MD: National Association of School Psychologists.

CHAPTER 21

Future Perspectives in Educational Psychology

GLORIA E. MILLER AND WILLIAM M. REYNOLDS

INTRODUCTION

Educational psychology is a branch of psychology that reflects a unique interdisciplinary tapestry with respect to theory and application. It is an applied science concerned with understanding learners, learning, and learning environments. In 1989, Wittrock and Farley defined the field as the development, evaluation, and application of theories and principles of human learning, teaching, and instruction to enhance lifelong educational activities and processes. A simplified definition proposed by Wittrock in 1992, was "the scientific study of psychology in education." The goal of this applied science has been and continues to be focused on aligning principles of curriculum, teaching, and education with respect to individual cognition, learning and motivational capacities within natural environments (McCombs & Miller, 2007, 2008). Michael Pressley (2005), in a provocative Thorndike career award address, identified educational psychology as the branch of psychology that has most constructively advanced education. Because of its dual focus, educational psychology often is viewed as a "bi-disciplinary" field representing a continuum of educational and psychological theory. O'Donnell and Levin (2001), in a review of contemporary educational psychology research, noted that this dualism has led to a healthy expansion of mission, methods, and contributions across both fields and Calfee (2006) has predicted this dualism will likely frame the field well into the future.

In the decade since the last edition of the *Handbook of Psychology*, the scope of work represented by educational psychology researchers has continued to expand, leading to many significant advances in theory, research, and practice. Educational psychologists have contributed significantly to our understanding of personal and situational variables that impact learning and successful teaching and schooling practices. Their contributions have been used by consumers, educators, and policy makers committed to the educational success of all students. Yet, it is difficult to define the field of educational psychology by a single line of inquiry or methodology. Educational psychologists conduct research across a wide range of topics, domains, and learning contexts (Alexander & Winne, 2006; Berliner, 2006; Reynolds & Miller, 2003). To capture this diversity, we organized the chapters in this updated handbook into the following five overarching domains: (1) *Cognitive and Regulatory Contributions to Learning, Development, and Instruction*; (2) *Sociocultural, Instructional, and Relational Processes*; (3) *Early Education and Curriculum Applications*; (4) *Psychology in the Schools*; and (5) *Educational Programs, Research and Policy*. A brief summary of the associated chapters within each domain is presented later with more specificity found in the opening chapter of this handbook (Reynolds & Miller, this volume).

Within the domain of *Cognitive and Regulatory Contributions to Learning, Development, and Instruction*, there are four chapters focused on how students explore and interact in their world as informed by research on contemporary theories of intelligence (Sternberg), self-regulated learning (Schunk & Zimmerman), metacognition (McCormick, Dimmitt, & Sullivan), and motivational constructs that impact classroom learning (Anderman, Gray, & Chang). The five chapters included in the *Sociocultural, Instructional, and Relational Processes* domain, focus on significant environment and cultural factors that reciprocally affect and are affected by the individual, with an emphasis on sociocultural contexts for teaching and learning (Mahn & John-Steiner); on moral and character development (Lapsley & Yeager); on cooperative learning and achievement (Slavin), on relationships between teachers and children (Sabol & Pianta), and on school adjustment (Wentzel). In the domain of *Early Education and Curriculum Applications*, there are four chapters with a specific emphasis on learning and curriculum applications related to early childhood education (Squires, Pribble, Chen, & Pomes), reading and literacy (Pearson & Cervetti), mathematics (Lehrer & Lesh), and media and technology (Goldman, Black, Maxwell, Plass, & Keitges). The four chapters included in the domain on *Psychology in the Schools* focus on individual differences in learning and development related to exceptional abilities such as giftedness (Olszewski-Kubilius & Thomson), behavior disorders (Walker & Gresham), and the practice of school psychology (Gettinger, Brodhagen, Butler, & Schienebeck). Finally, there are three chapters in the *Educational Programs, Research and Policy* domain that spotlight work on teacher training pedagogy (Whitcomb), the rigorous identification of credible educational intervention research (Levin & Kratchowill), and educational principles and policies that can enhance student learning, teacher training, and schooling practices (McCombs).

ORGANIZATION OF THIS CHAPTER

Our contributors represent some of the most prominent educational psychologists in the field today. Their work not only reflects the diversity of the field; it also exemplifies how critical psychological theory is applied to important educational issues. As active researchers, instructors, administrators, and mentors, their insights have informed key decision makers responsible for educational reform. Their contributions are sure to influence a new generation of educational psychologists. As in the first edition, authors were asked to synthesize historic issues and trends, to comment on critical work, and to discuss their impressions of current research likely to have a major impact on theory and application in the next decade. In this second volume, these requests were repeated with two additions: (1) to update research findings since the last edition and (2) to concentrate on how such work will continue to shape and improve education in the future.

The work reviewed here reflects the considerable advances in the field of educational psychology over the past two decades. Acknowledging this expanding knowledge base, the purpose of this final chapter is to present a synthesis of the major progress noted across the topical domains summarized in the preceding paragraphs in order to pose insights about how the field will evolve in the future. As in any selective review, it is impossible to adequately capture the full extent of the depth and breadth of the scholarship across these domains. In contrast to our prior chapter, where the focus was on theoretical, research and practice advances and limitations in the field (Miller & Reynolds, 2003), we opted instead to highlight seven thematic areas of progress consistently noted in the reviews of our contributors. These seven areas of progress were selected for their potential to influence future educational research and reforms.

1. Theoretical integration efforts.
2. Relational processes in educational settings.
3. Cultural influences on learning.
4. Biological influences on learning.
5. Effective assessment and evaluation practices.
6. Instructional advances.
7. Systemic efforts to improve education.

By capturing some of the major issues receiving critical attention by researchers in the field and forwarding potential ideas garnered from exemplars provided by our contributors, our hope is that these seven areas might stand as potential guideposts to inform educational consumers, practitioners, and policy makers. In the final section, we offer prospects for the field over the next decade, when the third volume of this handbook is slated for publication.

THEORETICAL INTEGRATION EFFORTS

Educational psychologists have continued to study knowledge acquisition, representation, and the generalization of new skills with a stronger focus on how intelligent behavior, problem solving, self-regulation, and metacognition intersect. As one example, Sternberg (this volume) asserts that self-regulation and metacognition can explain additional variance in academic performance and indices of creativity above and beyond intellectual ability. Students who perform well on cognitive and intellectual tasks may do poorly on academic tasks because they do not self-regulate or use metacognitive strategies and students with relatively weak cognitive abilities do better when there is strong evidence of these latter processes (Sternberg, 2003). Such findings may help explain why higher correlations between general intelligence and academic functioning have not been found. Self-regulatory and metacognitive processes such as goal setting, self-instruction, self-evaluation, comprehension monitoring, and self-efficacy, strongly influence cognitive endeavors (McCormick, Dimmitt, & Sullivan, this volume; Schoenfeld, 1992; Schunk & Zimmerman, this volume) and have been linked directly to academic progress (Lord, Diefendorff, Schmidt, & Hall, 2010).

Another example of theoretical integration is work on the intersection of cognitive and affective processes (Schunk & Zimmerman, 2008). Motivational researchers have made great strides in understanding how attitudes, expectancies and attributions affect our ability to organize, set goals, and enhance meaningfulness, which in turn, mediate our ability to sustain attention and transfer what we know to new situations (Anderman, DeLeon, & Gray, this volume). Indeed, one's perceived capability to do a task is related to choice, personal engagement, self-monitoring, and persistence in the face of difficulty (Schunk & Pajares, 2009). A belief that one is making progress towards an identified goal enhances self-efficacy and exerts motivational effects such as judgments of progress, anticipation of goal achievement, and sustained task persistence (Schunk & Zimmerman, 1998; Schunk & Zimmerman, this volume). Two overriding conclusions are (1) that students must be both cognitively and affectively engaged for deeper understanding and learning to occur and (2) that successful intellectual behavior and learning is by definition regulatory and metacognitive in nature. Understanding the the interplay between cognitive and affective processes has increased our knowledge of self-regulation and attributions for achievement and of social environments where students are motivated to excel (Vrugt & Oort, 2008).

Conceptual integration is also present in studies of sociocultural, instructional, and relational schooling processes. Such work, grounded in the work of Lev Vygotsky (1962, 1978), entails collaborative inquiry into culturally sensitive, interdisciplinary, and complementary relations that can explain learning and development (Mahn & John-Steiner, this volume). An integrative developmental systems theory has been forwarded to explain interpersonal and relational learning processes across home and school settings (Sabol & Pianta, this volume; Squires et al., this volume). Slavin (this volume) proposes a model of cooperative learning that incorporates evidence drawn from four theoretical perspectives: motivational, social cohesion, cognitive, and developmental. Theoretical integration also has occurred in regards to social engagement and interpersonal processes that promote academic adjustment, competence, regulation, and motivation (Wentzel, this volume; Zimmerman & Cleary, 2009). Lapsley and Yeager (this volume), likewise, discuss an integrative moral character education theory that provides a middle ground linking two previously distinctive research traditions—moral development and character education.

Important theoretical integration has continued across the curriculum domains of mathematics, literacy, science and technology and in research directed toward specific learner populations. The development of math skills and dispositions has been linked to discussion of narratives and to pretend play leading to new insights about how teachers can encourage conjecture, argument, and generalizations to foster later numeracy and mathematical understanding (Lehrer & Lesh, this volume). Integrative theories of reading have been studied that address individual as well as contextual factors related to automaticity, coordination, and regulation of critical letter- and word-identification, syntactic knowledge, and comprehension processes. It is now widely understood that reading comprehension requires active and iterative coordination and regulation of many general and domain specific cognitive processes and skills (Pearson & Cervetti, this volume). Indeed, integrative work on word level, text-level, and setting-level reading analyses can be found in compendium volumes published in the last decade (Kamil, Pearson, Moje, & Afflerbach, 2011; Snowling & Hulme, 2005). Contemporary educational and psychological researchers have strived to capture the complex interaction between the reader, the text and the reading context (Kintsch, 1998, 2004). Reader goals, strategies, skills, and background knowledge, as well as text genres and features (e.g., headings, visual displays, lists, captions), and discipline-specific strategies (i.e., history, science, math) critically influence and determine comprehension. Early childhood researchers have continued to focus on reciprocal developmental influences that affect the whole child (Squires et al., this volume). This collaboration has reduced fragmentation of services among various systems serving young children and families and has strengthened the call for universal early childhood programming (Rose, 2010). Olszewski-Kubilius and Thomson (this volume) discuss a new integrative gifted education paradigm which based on a developmental trajectory model that examines personal, contextual, content domain, and psychosocial factors.

A final example of integrative work is reviewed by Goldman and her colleagues (this volume) relates to the advent of new digital educational multimedia technologies and synchronous telecommunication capabilities. Such "new" learning environments create networks for learners to engage in collaborative inquiry and cooperative partnerships. Studies of learning within these new environments stress cognitive and affective processes that occur through joint perspective-taking shared knowledge creation, problem solving, and regulation as one thinks in relationship with others (Plass, Homer, & Hayward, 2009). More flexible thinking attitudes (i.e., "gender-flexing") has been an unexpected yet positive outgrowth of these new virtual opportunities for exploration, invention, and imaginative sharing (Goldman-Segall, 1998). These learning contexts have created opportunities to study collaborative multi-domain models of learning over time leading to new instructional insights.

Future Issues Regarding Theoretical Integration Efforts

In the next decade, educational psychology researchers will continue to study fundamental and contextual learning processes in order to better understand mediators and moderators of engagement and learning across home, school and community settings. There has been movement in the last decade to bridge research paradigms and build consensus, but much work remains to be done to reconcile how intellectual, cognitive, metacognitive, self-regulatory, affective and motivational constructs theoretically and practically interrelate to affect student achievement (Veenman, Wilhelm, & Beishuizen, 2004). The cross-discipline collaboration already begun will lead to further unification and differentiation of critical constructs. Future work likely will help untangle complex issues underlying sociocultural, interpersonal, and moral processes that affect classroom performance and relationships. Future integration across domainsof learning also will provide new insights about how students allot attention, search memory, integrate new information into prior knowledge, draw inferences, and assess breakdowns of and repair comprehension. Interpersonal (i.e., off-line) and technological (i.e., on-line) cooperative learning advances will provide exciting new insights into distributive cognition, regulation, motivation, affect, and interpersonal relationships across time, place, and culture. Indeed, technological advances have the potential of creating unique and previously unfathomable research opportunities in educational psychology. Finally, educational psychologists will lead the way in the study of multidimensional constructs and contexts that affect learning and social experiences across the lifespan. We predict more productive "marriages" between educational researchers who focus on individual variables and those who focus on contextual and environmental transformations. This integrative work is likely to lead to new models of reading, writing, mathematics, and science learning and to new formative and summative evaluations and research methodologies that can ensure the best outcomes for all students.

RELATIONAL PROCESSES IN EDUCATIONAL SETTINGS

Contemporary educational psychology researchers, grounded in Vygotsky's sociocultural theoretical framework (1978) and the ecological systems theory associated with Urie Bronfenbrenner (1979, 1989), have significantly advanced our understanding of learning within interwoven spheres of influence. Dynamic relational processes across and within learning environments have been examined more closely as have the impact of these issues on students' academic and socioemotional development. In the past two decades, important interpersonal and setting mediators of intelligence, self-regulation, metacognition, and motivation have been related to achievement. Intellectual researchers have studied how personal learning goals help us adapt, shape, and select environments (Sternberg, this volume). Self-regulation, behavioral, and social factors have been identified that occur before, during, and after task engagement and that reciprocally influence classroom features and expectations of performance (Zimmerman, 2000). Relational conditions that increase motivation for learning also have been studied (Anderman et al., this volume). Personal choice and goal-setting strongly predict persistence, effort self-efficacy, and the belief that one is capable of performing well (Bandura, 1989). Such beliefs then influence goal orientation, representations of the purpose and utility of a task, beliefs about the importance of a task, and interest in a task (Schunk & Zimmerman, 2008). Learning environments and practices that support choice, goal-setting, and self-efficacy can enhance future achievement expectations and overall schooling outcomes for a large number of students (McCombs, this volume; Schunk & Pajares, 2009). The work of educational psychologists has clearly also has furthered our understanding of complex classroom and school-wide social processes that affect learning over time and across cultures (Mahn & John-Steiner, this volume). Likewise, cooperative learning researchers have systemically linked performance to situational, interpersonal, and task factors, such as group composition and the structure of group goals and accountability (Slavin, this volume).

Developmental systems theory, introduced in 2003 by Pianta and colleagues (Pianta, Hamre, & Stuhlman) and updated for this volume (Sabol & Pianta, this volume), has gained support for its ability to conceptualize ongoing and bidirectional relational learning processes. In this theoretical framework, multiple proximal (i.e., teacher and child characteristics) and distal factors (i.e., school climate and classroom features) are examined to assess their independent and joint influence on student learning and emotional attachments. Asimilar systems model of moral identity development has been forwarded that looks at enduring dispositional characteristics as well as social factors that impact moral commitment and behavior overtime (Lapsley & Yeager, this volume). Social relational factors in schools and communities, such as closeness, perceived support, and a sense of relatedness have been found to compensate for prior negative experiences (Bruder, 2010; Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Hughes, Lou, Kwok, & Loyd, 2008). Wentzel (this volume) reviews contemporary research with middle and high school students where school adjustment and engagement variables are strongly related to school climate as well as interpersonal adult and peer relationships. Thus, educational researchers have more systematically demonstrated the importance of personally relevant goals and social connections that affect motivational, social, and behavioral competencies highly predictive of successful performance both in and out of school (McCombs, this volume; Wentzel, 2009, 2010).

Educational psychology researchers who study domain-specific learning or who focus on specific learner populations also have contributed important new insights about relational processes that can foster learning in and out of school. The influence of family relationships and opportunities to engage in developmentally appropriate coordinated learning across settings have been an important focus of early childhood (Squires et al., this volume), gifted education (Olszewski-Kubilius & Thomson), behavior disorders (Walker & Gresham), and school psychology researchers (Gettinger et al., this volume). Another example is research on the important influence of adult interactions during children's pretend play and storybook discussions on the development of mathematical understanding (Lehrer & Lesh, this volume). Interpersonal exchanges that encourage students to formulate arguments about possible states of affairs even in light of counterfactual evidence offer important opportunities to coordinate representations of true and false states of affairs that lead to later success on math and reading tasks (Amsel & Smalley, 2001). Goldman et al. (this volume) stress social relational process as a critical component of their points of viewing theory (POV-T) stressing that new technological learning environments (i.e., "perspectivity technology," Goldman-Segall, 1998) allow students to meet virtually, chat synchronously, and share their worlds through virtual work on collaborative projects. As such they provide new relational opportunities for diverse learners to come together in communities of practice to think deeply about complex issues (Wenger, 1998).

Future Issues Regarding Relational Processes in Educational Settings

Educational psychology researchers will continue to unpack the complex relational processes that contribute to learning and adjustment from preschool to high school. In the future, studies will be designed to investigate multiple and reciprocal relational constructs to explain intelligence, self-regulation, metacognition, and motivational processes across a variety of settings (Dinsmore, Alexander, & Loughlin, 2008). Critical relational attributes, contextual characteristics, and situational demands that change with age and across settings will be identified that can enhance schooling and life success (Pianta & Stuhlman, 2004). Educational psychology researchers also will study how sociocultural and environmental variables scaffold and support student learning across cultures both in and out of school and within virtual settings. Systemic, longitudinal studies of coordinated learning opportunities will help tease apart the relative influence and contribution of peers, family, and teachers on school adjustment, self-regulation, and other competencies needed to successfully progress through school in the United States. This work will lead to a better understanding of home and community variables that encourage students to exert control and engage more fully in the learning process. By increasing our understanding of individual competencies and social-relational constructs that affect learning, we will be able to design more successful differentiated environments and strategies to support the performance of all students, especially those identified as high risk (Walker & Gresham, this volume), learning disabled (Gettinger et al., this volume) or as gifted and talented (Olszewski-Kubilius & Thomson, this volume).

CULTURAL INFLUENCES ON LEARNING

Cross-cultural studies of intelligence and other cognitive and regulatory process related to learning and development have increased in the past two decades (Greenfield, et al., 2006). In Eastern cultures where Confucian, Taoist, Buddhist, or Hindu perspectives dominate, notions of intelligence include characteristics such as benevolence, doing what is right, humility, knowledge of oneself, and determination (Yang & Sternberg, 1997). Similarly, in many African cultures there is an emphasis on social responsibility, cooperation, and participation versus verbal and analytical abilities (Serpell, 1993). A "good child" is viewed as having both logical thinking skills as well as skills that make a person a respected and valued community member (Dasen, 1984). Sternberg (this volume) draws two conclusions from this body of work: (1) that implicit theories of intelligence go far beyond what conventional psychometric intelligence tests measure and (2) that intelligence entails practical problem solving, verbal ability, as well as social competence. Cross-cultural studies of self-regulation, metacognition, and motivation also suggest that it may not be warranted to assume such constructs and processes operate similarly across cultures (Schunk & Zimmerman, this volume). Cultural values, traditions, and beliefs strongly affect our perceptions of social learning environments and views of self-regulation have been found to differ across Western and non-Western cultures. For example, it has been suggested that goal setting and autonomy are culturally bound (Ryan & Deci, 2006; Winne & Hadwin, 2008) in that students who display self-regulated behavior in one setting (i.e., the home) may not do so in other situations (i.e., school) (Jang, Reeve, & Deci, 2010; Murayama & Elliot. 2009; Veenman, Van Hout-Wolters, & Afflerbach, 2006).

Sociocultural researchers, who study how humans learn with others and with the support of culturally constructed tools, signs, and practices, also have broadened our understanding of culture and its role in shaping mental representations and learning (Mahn & John-Steiner, this volume). Meanings and systems of meaning are internalized as students and teachers use socially mediated artifacts and engage in culturally situated learning activities (John-Steiner & Mahn, 1996). Past learning experiences contribute to the acquisition of new knowledge as they become internalized as higher psychological processes (John-Steiner, 2000). Prior exposure to sign-symbol systems and certain types of mental representations or schemas have been found to impact the acquisition and representation of new knowledge (John-Steiner & Mahn, 1996). The development of play, reading, writing and second language skills are affected by differences in communicative systems especially in cultures where visual and kinesthetic (i.e., drawing, dance) versus verbal or linguistic communicative systems predominate (John-Steiner, 1995; Lantolf & Beckett, 2009). Teaching that builds on the central ways that people make sense of and communicate in their world has been found to enhance understanding (Lima, 1998) and to affect preferred future learning approaches (Collignon, 1994).

Over the past two decades researchers also have focused on how culture influences internalized learning and achievement goals over time (Laible & Thompson, 2007; Wentzel & Watkins, 2010). Educators not only transmit knowledge, but also model and emit cultural expectations, resources, and advice (Pianta & Stuhlman, 2004; Wentzel, this volume). Recent international and cross-cultural work in the United States has established important perceptual distinctions regarding student-teacher relationships, the value placed on such interpersonal relations, and the degree to which students express and pursue educational goals valued in their communities versus those expressed by educators (Joshi, 2009; Jussim, Robustelli, & Cain, 2009). Such culturally defined relational processes have been found to play a role in fostering social, motivational, and academic achievement expectations (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Educational psychology researchers have improved their ability to document culturally defined achievement goals and processes (Dowson & McInerney, 2003) that can affect outcomes during individual and cooperative learning paradigms (Cooper & Slavin, 2004; Slavin, this volume). Moral identity researchers also have studied how individual and institutional cultural factors play a decisive role in transforming personal goals into moral commitment and behavior (Lapsley & Yeager, this volume). This work has led to a greater understanding of how students' from different ethnicities and cultural backgrounds regard the purpose of education, socially desirable outcomes, and what constitutes an ideal student (Ogbu, 1985; Wentzel & Looney, 2007).

Finally, educational researchers have studied cultural tools and activities that can amplify and foster critical achievement skills. In regard to mathematics, Lehrer and Lesh (this volume) review important cultural precursors to mathematical thinking that are linked to opportunities to engage in sound argument that parallels scientific debate or "proof." Mathematical argument is enhanced when one is asked to clarify personal ideas, to discuss problematic events in need of resolution, or to challenge causal explanations of an event. Narrative discussions and pretend play are two culturally embedded activities that provide opportunities to promote such mathematically oriented dialogues both in and out of school (i.e., dinnertime discussions). Cultural differences in the provision of such justification discussions have been linked to developmental aspects of mathematical thinking. Likewise, researchers in gifted education have advocated a shift to culturally sensitive talent identification and development approaches to better serve a more diverse group of students and to tailor outside-of-school programs, mentors, and career experiences (Neihart, 2007; Olszewski-Kubilius & Thomson, 2010).

Future Issues Regarding Cultural Influences on Learning

Social processes that shape thinking, learning, and the transmission of knowledge are embedded in cultural contexts. Research conducted in the field of educational psychology has increasingly focused on how cultural processes become internalized as intellectual, regulatory, and motivational abilities to impact achievement outcomes and schooling success (Mahn & John-Steiner, 2005). Much more work is needed. however, to illuminate the multiple ways that educational values and expectations are communicated by parents, teachers and peers and how cultural values and expectations align with or differ from those espoused by our educational institutions (Wentzel, this volume). Another promising area of future research is how cultural factors affect classroom relations, structures, and climate across grades and content areas. In the next decade, educational psychology researchers will more systematically consider diverse populations in order to broaden our knowledge of universal as well as culture-specific learning contexts, expectancies and processes. This work will provide insights about how to design social contexts that motivate achievement, learning and social adjustment in the United States to help meet the educational needs of our increasing linguistic and culturally diverse student population (Slavin, this volume). Indeed, in 1999, a bipartisan national committee forwarded educational reform recommendations for the next century that are still relevant today. This panel of experts called for educational researchers to study variations across as well as within cultural communities to better understand the ways in which knowledge is transferred and encouraged as one means of systematically improving U.S. school environments (National Research Council, 2010). Educational psychologists have and will continue to lead the way in such endeavors.

BIOLOGICAL INFLUENCES ON LEARNING

Tremendous advances in the study of the brain, neural functioning and behavioral genetics have led to important research to disentangle the issue of the genetic versus environmental sources of variation in intelligence (Sternberg & Grigorenko, 1997). Educational psychologists have increasingly been involved in studying the intersection of cognitive neuroscience, interpersonal relations, and motivation (Fisher, Marshall, & Nanayakkara, 2009). One example is work regarding individual differences in nerve-conduction velocity that may contribute to differing levels of intelligence and regulation of cognition (Plomin, DeFries, McClearn, & McGuffin, 2008). Another example is the integration of physiological measures, such as physical reactions (heart rate) and brain functioning (blood flow), with more traditional verbal and analytical tests of intelligence, cognitive information processing, and self-regulation to study learning processes (Sternberg, this volume). This type of integrated work has led to more precise examinations of biological and environmental moderator and mediator variables (Murayama & Elliot, 2009; Sternberg & Grigorenko, 1997).

Sociocultural theorists, steeped in Vygotsky's theory, also are studying the origin of mind and its evolutionary development as a system of biological, cultural, and social influences (Mahn & John-Steiner, this volume). The goal is to better understand how biologically based processes contribute to and function within dynamic, culturally defined teaching and learning contexts (John-Steiner & Mahn, 2003). Motivational and self-regulation researchers have begun to describe how achievement goals and beliefs about ability, values, and attributions might operate at a neuronal level and have been investigating how a "goodness of fit" between such personal dispositions and contextual settings can influence learning and development (Anderman et al., this volume; Hamre & Pianta, 2005). Contemporary models of moral functioning and expertise have been linked to human dispositions and to explicit experiences that increase one's ability to perceive and to make moral judgments (Narvaez & Lapsley, 2005).

Other research on biological influences involve brain scanning studies conducted during digital media interactive learning opportunities (Goldman-Segall, 1996). These studies have shown that multiple sensory and perceptual systems are engaged during such virtual learning tasks (Black, 2010). CONNECT BELOW Eye tracking and neuro-imaging techniques during online or ongoing reading tasks also have led to considerable new insights about comprehension and linguistic memory (Pearson & Cervetti, this volume). In recent years, educational psychology researchers have been studying how readers attend to and utilize phonological awareness of sounds operating at a subword level to approach the reading of new words (Ehri, 1999 & 2005). New advances also have been made about how readers select information for retention in working memory (Oakhill, Cain, & Bryant, 2003) or instantiate background word and world knowledge (S. Stahl & K. Stahl, 2004; Snowling & Hulme, 2005). Many neurological processes have been found to be necessary but not sufficient for predicting the complex types of comprehension processes required to succeed and achieve in school (Pearson & Cervetti, this volume). Thus, researchers have proposed situated models of reading comprehension, that reflect both innate, largely automatic and unconscious mental representation of text coherence as well as strategic, reader or teacher-controlled instructional processes (Kintsch, 2004; Ruddell & Unrau, 2004).

Future Issues Regarding Biological Influences on Learning

Biological and neurological researchers interested in learning have only just begun to investigate underlying physiological, brain development related to achievement constructs such as academic competence, goals, expectances, and relational processes (Pea, Bransford, Brown, & Cocking, 2000). Future work by educational psychologists in conjunction with neuroscientists will continue to illuminate cognitive, metacognitive, and motivational aspects of learning in order to understand their impact on school success. In fact, Sternberg (this volume) suggests that biologically based theories of intelligence and learning will play an increasing role as researchers, educators, and policymakers seek ways to improve academic achievement for all students. In the next decade, it is likely that we will see a growing number of studies merging brain research with work on classroom relationships, cooperative learning, and school adjustment. A greater appreciation of how the brain functions, especially in regard to the development of cognitive, regulatory, emotional, and motivational competencies in the context of interpersonal relationships, will improve our understanding of effective instruction. Awareness of brain processes that take place during reading, writing, mathematics, and other academic domains will facilitate the design of more effective teaching strategies and classroom and computer learning environments that can meet the needs of a wide range of students.

EFFECTIVE ASSESSMENT AND EVALUATION PRACTICES

Educational psychologists have played a key role in the development and validation of new approaches to measure intellectual, regulatory and motivation attributes important not only for success at school but also at work (Sternberg, this volume). Researchers over the past decade also have continued to develop new theory-driven assessments to capture complex interpersonal relationships and learning processes. For example, the measurement of intelligence has moved beyond analytical and verbal abilities to place greater emphasis on socially constructed attributes that include the ability to understand and control one's cognitive endeavors, what Sternberg has labeled *implicit theories* of intelligence (2003, this volume). These abilities are far more likely to be observed as people make choices and solve personal and professional problems during daily work and life situations. More recent assessments of self-regulation and metacognition have asked learners to make predictions or judgments about an upcoming task, which are then compared to their actual performance. Online decisions during computer assisted learning tasks also have been used to measure such processes (McCormick et al., this volume; Winne, 2010). Observation, online methods, computer simulations, eye tracking, and neuro-imaging techniques also have been developed to assess automatic and reader-controlled processes (Kintsch, 2004; van den Broek, Young, Tzeng, & Linderholm, 2004). Other assessment innovations include multimodal and multi-informant approaches employed before, during, and after task engagement to capture changes over time (E. Anderman & L. Anderman, 2010; Koskey, Karabenick, Woolley, Bonney, & Dever, 2010). In addition, dynamic assessments that consider a student's zone of proximal development have been developed to gauge gains in performance after short-term instructional modifications (Mahn & John-Steiner, this volume; Veenman et al., 2006). These approaches have been validated for general intellectual processing as well as for reading, writing, and mathematics performance (McCormick et al., this volume; Pearson & Cervetti, this volume; Schmittau, 2004).

Assessment advances also have led to new evaluations of the emotional quality of classrooms and interpersonal relations that can affect learning. Reliable and valid measures have been developed to capture key relational constructs such as closeness, perceived support, acceptance, and willingness to utilize a teacher (Sabol & Pianta, this volume). Slavin and Goldman et al. (this volume) review significant advances in how to evaluate cooperative classroom or on-line partnerships. New technologies that incorporate digitally networked collective inquiry and synchronous telecommunication capabilities have led to new appraisals of learning never before possible (Goldman, Pea, Barron, & Derry, 2007). Assessments within such environments have begun to focus on the shared learning that occurs across multiple minds working in collaboration. Computer technologies also have broadened our ability to investigate and capture adjustments in how students relate to each other as they create and formulate understandings of their world. Cooperative virtual learning environments provide fertile new ground to observe how students think and jointly construct knowledge that goes far beyond largely individualistic, cognitive outcomes (Goldman et al., this volume).

Universal screening and progress monitoring are two other assessment advances championed by educational researchers. Universal screening involves performance measures, observations, or adult ratings reliably administered to all incoming students into a classroom or school. These assessments are completed to facilitate early identification and general remediation for preschool students (Squires et al., this volume), and students with learning difficulties or disabilities (Gettinger et al., this volume), special talents and giftedness (Olszewski-Kubilius & Thomson, this volume), or behavior disorders (Walker & Gresham, this volume). Such screening advances enable educators to quickly identify students who may require more intentional and explicit instruction in order to learn critical academic, social, and behavioral strategies (Lehrer & Schauble, 2005, 2007; Pearson & Cervetti, this volume; Walker & Gresham, this volume). Progress monitoring refers to curriculum-based assessments of performance overtime. One such progress monitoring approach, called curriculum-based measurement (CBM), involves brief, reliable, timed measures of leveled academic performance repeatedly administered over time (e.g., words read correctly per minute, math problems solved correctly per minute) (Hintze, Christ, & Methe, 2006; Shinn, 2010). These new assessment tools are sensitive to changes in a child's academic performance following an intervention and are predictive of long-term academic performance. However, they are not sufficiently diagnostic and thus, educational psychologists have continued to be at the forefront of developing and validating other curriculum-based approaches to identify specific skill deficits in reading, math, spelling, and written expression that facilitate the development of targeted remediation efforts (Deno, 2005; VanDerHeyden & Burns, 2005). Such assessments have been increasingly employed to analyze, plan, and evaluate the educational needs of students with learning challenges (Gettinger et al., this volume), emotional or behavioral issues (Walker & Gresham, this volume) or for linguistically diverse, second language learners (Torres-Velásquez, 1999, 2000). Olszewski-Kubilius and Thomson (this volume) also cite ongoing work to develop performance- and curriculum-based assessments that can more appropriately identify exceptional talents and giftedness, especially among culturally and linguistically diverse students from impoverished backgrounds.

Future Issues Regarding Effective Assessment and Evaluation Practices

One future assessment challenge for educational researchers is that different research traditions and theoretical orientations have been employed to define similar constructs. McCormick et al. (this volume) point out that this has caused definitional confusion, overlapping constructs, and "fuzzy" boundaries between metacognition, self-regulation, and executive function. Self-regulation is considered a broader concept than metacognition since it involves an underlying sense of self-efficacy and personal agency as well as motivational and behavioral processes, but executive function includes aspects of both metacognition and self-regulation and typically refers to skills, such as response inhibition, emotional control, sustained attention, task initiation, flexibility, and goal-directed persistence. Differences may be attributed to populations studied and to one's theoretical orientation or background discipline (Anderman et al., this volume; Schunk & Zimmerman, this volume). Goldman et al. (this volume) reported similar concerns about theoretical constructs, basic terminology, and measures employed by researchers at various institutions working on new computer-assisted learning technologies. Great variability also exists in defining giftedness and talent leading to conflicting identification and educational practices (Olszewski-Kubilius & Thomson, this volume). Definitional and evaluation disparities have led to confusing and sometimes contradictory explanations of key concepts that have contributed to continued debates about development, learning and instruction. Thus, one goal of future educational researchers should be to promote greater definitional consensus and conceptual unity while encouraging more diversified assessment and evaluation approaches. Further advances also are needed to develop valid, culturally-sensitive, and authentic assessments of individual and group performance across domains especially for underrepresented populations (Pressley, 2003). Assessment innovations in the future also will focus on ongoing interactions, decision making, and goal setting during real-life situations that occur within home, school, work, and community settings. Examples might include observations of small collaborative decision-making groups, daily gatherings such as lunchtime or dinnertime conversations, playground activities, or other practical daily living and work endeavors. Future educational psychologists will also develop new ways to assess processes that occur before, during, and after learning within a content area domain. Measures also are needed to capture reciprocal interrelationships and constructs related to academic potential and progress. The advent of interactive computer environments will continue to shape the way we view assessments of individual and group learning (Goldman, Crosby, Swan, & Shea, 2004; Greene & Azevedo, 2010). Goldman et al. (this volume) predict that online measures, either directly or unobtrusively collected during collaborative problem solving, distributed learning, or joint casework will lead to more sophisticated and functional formative and summative appraisals than now currently possible.

Finally, educational psychology researchers will continue to develop innovative ways to monitor affective as well as behavioral and social-emotional progress (Walker & Gresham, this volume). The creation and validation of new progress monitoring tools that build on systematic observations, curriculum-based measures, third-party ratings, and other change sensitive assessments will continue to emerge within the next decade. Such assessment advances will help to further establish socially relevant benchmarks about expected rates of improvement and allow for the examination of cognitive, social, and emotional learning attributes, skills, and processes that develop over a lifetime. Ultimately, this work will lead to more efficient early identification of students not responding adequately to general instruction so that collaborative school-based teams can quickly and carefully determine whether an educational intervention or adaptation should be continued, adjusted, or terminated (Gettinger et al., this volume).

INSTRUCTIONAL ADVANCES

National education reports over the past two decades have consistently pointed to a substantial rise in the number of students entering school already behind or who are at risk of falling behind and failing in this context. These reports reveal significant achievement gaps between different racial and disability populations attending U.S. schools. Educational psychologists have been at the forefront of empirically driven practice to address these issues with students exhibiting a wide range of academic, social as well as health and mental health issues (Gettinger et al., this volume). Instructional innovations have occurred within the field of early childhood (Squires et al., this volume) and gifted and talented education (Olszewski-Kubilius & Thomson, this volume), as well as within the field of emotional and behavioral disorders (Walker & Gresham, this volume). Significant instructional advances in the last decade have been linked to improvements in teaching and school climate that can increase student engagement and performance and reduce bullying, peer harassment, and other school-related violence. Instructional innovations designed and evaluated by educational psychology researchers are organized below into those focused on individual learners, whole classrooms or groups of learners, and computer-based learning environments.

Individual Instructional Innovations

Individually focused intervention advances have been developed to overcome both production (i.e., failure to generate effective strategies) as well as mediational deficiencies (i.e., when strategies do not affect subsequent learning outcomes) (Pressley, 2006). Educational psychologists have continued to develop and evaluate theoretically driven, individualized interventions to improve reading, writing, and language skills as well as mathematics, science, and problem solving. Pearson and Cervetti (this volume) summarize the large body of reading instruction research that has spanned subword (phonemic and orthographic awareness), word recognition (phonics and sight words), word meaning (vocabulary), as well as text-level (comprehension) processes. Interventions for each of these areas have increasingly emphasized the intersection of situated content as well as a reader's prior knowledge, skill level, and purpose for reading in order to improve retention, generalization, and application of learning over time. Lehrer and Lesh (this volume) review instructional innovations to enhance children's natural development of math inscriptional tools, including distinctions among alphabetical, numerical, and other forms of inscription an appreciation of symbolic inscriptions used in maps, scale models, pictures with notations, and as external memory aids; and finally, inscriptions that can help solve problems (Lee, Karmiloff-Smith, Cameron, & Dodsworth, 1998). Promising instructional enhancements also have been developed in the domains of social emotional learning for young children (Squires et al., this volume), for students with exceptional talents and abilities (Olszewski-Kubilius & Thomson, this volume), and for students exhibiting social, emotional and behavioral challenges (Walker & Gresham, this volume).

Educational researchers have also continued to highlight the importance of scaffolding that occurs when instruction is provided within a child's "zone of proximal development" (Mahn & John Steiner, this volume). Investigations of scaffolding have been conducted across various academic domains. In regard to mathematics instruction, teaching models that provide frameworks or metaphors to help students make sense of experiences have been implemented (Kelly & Lesh, 2000; Lehrer & Schauble, 2000). Purposeful descriptions (written or spoken) or depictions (pictures, diagrams, graphics, or concrete structures) as well as more complex express-test-revise modeling have been studied. Scaffolded instruction and curriculum materials have been found to contribute to more sophisticated and complex thinking, reasoning, and explanation in regards to math (Lehrer, Kim & Schauble, 2007) and reading (Taylor, Pearson, Peterson, & Rodriguez, 2003).

A third individually focused instructional innovation in the last decade is the focus on how to blend academic with regulatory, motivation, and affective skills and strategies. Expert performers in many fields can logically explain how they solve problems but also include comments about feelings, values, dispositions, and a variety of metacognitive or regulatory functions (Carr, 2010; Lesh, 2002). These factors have been used to design instructional enhancements when teaching a new skill, such as self-checking, suggestions to stop and reread, or the incorporation of a self-instructional plan (McCormick et al., this volume; Pearson & Cervetti, this volume; Pressley, 2003). Other enhancements encourage personal choice and goal-setting to increase one's sense of personal accomplishment and confidence and appreciation that effort promotes progress (Patall, Cooper, & Wynn, 2010; Schunk & Zimmerman, 1998; Schunk & Zimmerman, this volume). Students who receive such enhanced instruction not only demonstrate higher achievement than non- or alternatively instructed students; they also evidence sustained interest and desire for further growth and mastery (Anderman et al., this volume; Wentzel, this volume). Learning enhancement strategies also contribute directly and indirectly to success both in and out of school and these findings are especially robust for emotionally and behaviorally at risk children and youth (Gresham, 2010). A common theme is that successful instruction of any kind (i.e., cognitive, academic, behavioral or social, emotional) is greatly enhanced when change is viewed as a two-stage process that requires one set of procedures to produce a skill and another set of procedures to sustain and generalize it (Walker, Ramsey, & Gresham, 2004).

Classroom Instructional Innovations

Recognizing that content knowledge alone is insufficient to produce competent lifelong learners the past decade has seen a tremendous rise in studies of classroom practices that create motivating, exciting, and inviting learning environments (McCombs, this volume). Such environments promote choice and personally meaningful goals and positively influence self-efficacy, self-regulation, and other achievement motivation factors linked to academic engagement (Anderman et al., this volume). Educational psychologists have studied effective classroom practices that allow children to master a range of cognitive, metacognitive, motivational attributes, and achievement focused skills (Sabol & Pianta, this volume; Squires et al., this volume). Mathematics researchers have stressed teaching practices that "revoice" student comments during discovery learning and that draw attention to central mathematical concepts through justification discussions (Lehrer & Lesh, this volume; Sherin, Jacobs, & Philipp, 2011). Mahn and John-Steiner (this volume) review classroom verbal meditational strategies that enhance academic performance in students who are second language learners. Cooperative learning theorists have focused on classroom activities rooted in authentic inquiry that occur within a community of individuals (Slavin, this volume). Such collaborative learning opportunities allow a group to accomplish complex tasks that would be less likely if attempted by one individual.

Another important classroom instructional factor that has received more attention in the past decade is how to foster learning across school, home, and community settings. Student achievement, school engagement, and social emotional well-being is enhanced when experiences in-school and out-of school are coordinated and complimentary (Gettinger et al., this volume). Successful studies of partnerships between schools and families have been conducted and linked to important school-wide achievement metrics (Christenson & Reschly, 2010). Home-school collaboration is a central component of successful child and school performance (Peacock & Collett, 2010; Sheridan, Taylor, & Woods, 2008) and is best achieved through efforts that build relationships, increase communication and lead to joint learning and evaluation efforts to improve student outcomes (Ervin & Schaughency, 2008; Lines, Miller, & Stanley, 2011).

Technological Instructional Innovations

Educational psychologists have been at the forefront developing and evaluating computer based learning environments (i.e., CBLEs) designed to improve general learning processes as well as literacy (Pearson & Cervetti, this volume), mathematics, science, and problem solving (Lehrer & Lesh, this volume). As McCormick et al. (this volume) point out, CBLEs have many advantages over traditional instruction and may be a critical new tool to advance learning for many students. The relative efficacy of human over computer instruction is not disputed, since it is unlikely that the adaptive scaffolding provided by a human tutor can be programmed entirely into a CBLE environment. Rather, the majority of studies conducted over the past decade have focused on examinations of the interplay of instruction provided by effective teachers in combination with CBLE practice. For example, computer tools have been developed that allow students to construct shapes through a series of computational statements that move a turtle figure (Harel & Papert, 1991) or to form new shapes by pulling and dragging points on a figure (Chazan & Yerushalmy, 1998). Computer environments like these allow students to visually express, transform, and design geometric concepts, which is considered a special form of mathematical literacy (Newcombe & Huttenlocher, 2000). CBLEs can increase knowledge of important concepts and also provide a fertile ground for conjecture, experimentation, and understanding of mathematics (Jacobson & Lehrer, 2000; Lehrer & Lesh, this volume).

Technological innovations have also been developed to build upon the way students think about and interact with their world. (In the past decade, educational researchers have begun to investigate hypermedia platforms and embodied learning environments where multiple sensory modalities (e.g., visuals, voiceovers, gestures, movement) and video-game-like situations allow direct manipulation and simulations so students more directly experience a phenomenon (Black, 2010). Such environments have been hypothesized to encourage students to plan, set goals, activate background knowledge, employ metacognitive monitoring, and self-reflect during task performance (Azevedo & Cromley, 2004). Indeed, Goldman and colleagues (Goldman et al., 2007) recently reviewed a number of computer programs and other technological advances that show great promise for fostering greater learning, understanding and motivation through virtual environments that also promote a greater appreciation of diverse customs, languages, and points of view.

Future Issues Regarding Instructional Advances

Educational psychologists have made clear and significant contributions individual, classroom, and computer based instruction that can improve school functioning and adjustment. Learning is enhanced when it is differentiated to meet targeted student needs; builds upon personal, creative, and social-emotional abilities; helps students to adopt self-monitoring and other motivational, regulatory strategies; and fosters coordinated learning across school, home and community settings. Although evidence is accumulating that critical school and life skills can be taught, some instructional approaches have received more validation than others (Schunk & Zimmerman, this volume). The research conducted by educational psychologists in the future will continue to uncover critical instructional practices to enhance intellectual, cognitive, affective, and self-regulatory skills that promote literacy, science, and mathematics learning. This work will lead to the study of a wider array of instructional approaches, particularly at the secondary level and with students identified as gifted and talented (Sternberg & Davis, 2005) or as having serious social-emotional or behavioral problems (Walker, Severson, & Seeley, 2010).

Educational psychologists also will continue to evaluate promising individual and classroom instruction that can help students set realistic and achievable life goals and increase their school engagement and achievement expectancies, especially with students from traditionally underrepresented minority groups. Strategic interventions will be developed to promote the coordination and regulation of complex cognitive processes across a variety of content domains (Pearson & Cervetti, this volume). Instructional variables will be identified that merge discipline-specific content strategies with learner preferences and academically oriented goals. Longitudinal studies also will be designed to more specifically examine how early academic instruction can be broadened to positively influence later performance in later academic disciplines such as algebra, science, history, and chemistry (Shanahan et al., 2010; Vrugt & Oort, 2008). Researchers interested in instructional innovations also will continue to consider teacher preparation and professional development strategies (Whitcomb, this volume) to help teachers work more effectively with diverse populations (Hollins & Torres Guzman, 2005). Teachers are needed who can coach, guide, model, and scaffold learning though thoughtful and cognitively challenging discussions (Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009; Pearson & Cervetti, this volume). Many authors also stressed the need for future instructional studies of longer duration, conducted across multiple situations and populations, and embedded more fully into academic curriculum Instructional research of this nature will improve generalization across settings and lessen the discouraging finding that students rarely apply skills taught in one class to other classes. Progress in these areas will increase our ability to design instruction that capitalizes on personal and situational strengths and compensates for weaknesses to best meet the needs of our increasingly diverse student population (Banks et al., 2005).

Finally, instructional research will progressively focus on the interface of human and computer based learning. Understanding the nature of such environments will lead to new insights about shared learning (Lave & Wenger, 1991). Educational psychology researchers will likely study how technology can be flexibly adapted to meet the unique needs of individual learners and classroom settings (Azevedo & Cromley, 2004). Additionally, research will continue to focus on digital networks, online game play, and virtual communities of practice (Brown, Collins, & Duguid, 1989). This work will increase our knowledge of technology systems and CBLE environments that can build bridges across the human experience and ultimately improve achievement outcomes for the increasing number of disenfranchised youth in our society (Goldman et al., this volume; Slavin, this volume). As Goldman, Black, Maxwell, Plass, and Keitges (this volume) so eloquently state, future educational psychology researchers will increase our appreciation of computers not just as tools used by our culture but rather as tools for making culture and building understanding of the world.

SYSTEMIC EFFORTS TO IMPROVE EDUCATION

Educational psychologists have played an increasing role in the development and evaluation of systematic efforts to improve education. In the past decade, major contributions have been made in regards to initial teacher preparation, establishing rigorous standards for educational research, and the design of multi-tiered service delivery models. These advances have been linked to improved school outcomes and exciting educational innovations.

Teacher Preparation

Educational psychology researchers have continued to delineate teacher dispositions, beliefs, values, and attitudes that guide everyday instructional judgments and decisions (Villegas, 2007). Critical teaching practices have been studied that boost students' self-regulation and self-efficacy (McCormick et al., this volume) and that contribute to positive cognitive and affective outcomes (Pintrich, 2003). Stronger evidence now exists regarding the importance of interpersonal processes and relationships between students and teachers (Sabol & Pianta, this volume). Learner centered teaching principles that stress choice, personal goal setting, and self-reflective thinking lead to stronger interpersonal connections between teachers, students and families (see McCombs, this volume) and to greater success in the heterogeneous classrooms of today's society. Teachers' ability to orchestrate productive classroom discourse requires distinct forms of pedagogical knowledge. In regards to math instruction, this knowledge has been referred to as "mathematics knowledge for teaching" or (MKT) (Ball, Sleep, Boerst, & Bass, 2009). MKT is reflected in modeling and explanations of proof and reasoning, in recognizing unconventional solutions and typical errors that students make, and in the ability to provide impromptu explanations and examples that develop students' appreciation of a particular idea or process. Teachers characterized by high levels of MKT relative to their peers have been found to conduct lessons rich in mathematical conceptions and thinking (Lehrer & Lesh, this volume). Effective MLK helps teachers anticipate and analyze student errors and misconceptions that can block learning and this specialized pedagogical knowledge is distinct from simple content knowledge (Ball, Thames, & Phelps, 2008).

Educational psychologists have continued to study how teachers develop this knowledge as part of their professional identity (Darling-Hammond & Bransford, 2005). Researchers concerned with teacher preparation have stressed that the "heart" of learning to teach is the ability to exercise sound judgment for particular purposes in specific social and cultural contexts (Whitcomb, this volume). Exceptional teachers not only have to master basic skills; they also must exhibit a deep conceptual understanding of how to assess and promote student learning by extending lessons beyond the basics (Borko & Putnam, 1996). For example, K-3 teachers who were asked to comment on a classroom video clip of Grade 1 to 2 students solving whole number word problems (discussed in Lehrer & Lesh, this volume), were more able to comment on the nature of students' mathematical strategies if they had received structured professional development in teaching math. The highest rated teachers were able to identify different states of emerging abilities in students and crafted instructional responses tailored to particular children.

Whitcomb (this volume) reviews the burgeoning work on initial teaching pedagogy (ITP) that has led to significant teacher preparation reform. This work stresses essential teaching knowledge, skills, and dispositions positively linked to the success of diverse student learners (Darling-Hammond & Bransford, 2005) and has been organized into three domains: (1) knowledge about learners and their development in social contexts, (2) knowledge about subject matter and curriculum, and (3) knowledge about teaching practices (Cochran-Smith & Fries, 2005; Darling-Hammond, 2006). Promising ITP approaches include solving real problems while working in small groups and reflecting on this learning (Sherin et al., 2011) and curriculum focused on "high-leverage" practices (Ball et al., 2009). Effective teacher training reforms have included year-long coursework, self-reflective teaching, artifact analysis, and self-observation (Borko, Whitcomb, & Byrnes, 2008; Feiman-Nemser, 2001). Case studies and apprenticeship learning, where a candidate works alongside an accomplished teacher who engages in guided practice and dialogue about the subtle nuances of teaching also have been employed to enhance teacher preparation (Cochran-Smith & Lytle, 1999; Bransford et al., 2005). These approaches have lead to more sophisticated professional development models based on theoretically-grounded practices found in experienced teachers (Khortagen, 2010). Grossman, Hammerness, and McDonald (2009) recently have titled this ongoing work as understanding the pedagogies of reflection, investigation, noticing, and enactment.

Credible Research

Educational psychology researchers have been at the forefront of efforts to educate the public about scientific integrity and credible evidence (Hsieh et al., 2005). Building on their review a decade ago, Levin & Kratochwill (this volume) reiterate the need to ensure the credibility of educational and psychological research using the rigorous criteria of inquiry recently advanced by the National Research Council (2010). While randomized controlled trials are essential to make causal claims, there also is an acknowledgment that research from multiple disciplinary lenses and using multiple methods is essential to understanding the complexity of educational activities and outcomes. In this respect, a conceptual framework more like the field of medicine is forwarded. This stage process of educational inquiry begins with pilot studies, proceeds to a combination of controlled laboratory experiments and classroom-based design experiments, and culminates in well-designed, randomized trials that can lead to more informed classroom practice. Levin & Kratochwill (this volume) believe that such a model will help resolve and overcome persistent and divisive ideological framings so that important educational issues can be more adequately addressed (Cochran-Smith & Fries, 2005).

The need for rigorous and empirically-valid intervention research also has been part of a national reform movement calling for evidence-based interventions (EBIs), (Levin & Kratochwill, this volume). Such research would unequivocally rule *in* the intervention as the proximate cause of the observed outcome and at the same time rules *out* alternative accounts for observed outcomes. EBI research would also lead to more successful independent replications over time (Levin, 2004). Levin and colleagues (Levin, 1994; Derry, Levin, Osana, Jones, & Peterson, 2000) have discussed key internal and external validity criteria by referring to the acronym "***CARE***ful". These features are summarized in the following statement: "If an appropriate ***C***omparison to an alternative or nonintervention condition reveals ***A***gain and again, evidence of a direct ***R***elationship between an intervention and a specified outcome, while ***E***liminating all other competing explanations for the outcome, then the research yields scientifically convincing evidence of the intervention's effectiveness" (Levin & Kratochwill, this volume). National outlets such as the U.S. Dept of Education Institute of Education *What Works Clearinghouse* (2008) that disseminate information about EBIs were reviewed by many of our contributors.

Multitiered School System Reform

A model of service delivery recently forwarded by scholar-researchers in the field involves coordinated, multilevel interventions to ensure that *all* students within a school receive needed supports. Essential characteristics of this model were outlined in Walker and Gresham (this volume) and include the early detection of students with emerging academic, social and behavior concerns, investment in primary, secondary, and tertiary forms of prevention; a proactive rather than a reactive stance, and the use of evidence-based practices and approaches like those referred to in the previous section. In this model, universal screening helps identify students who may be at risk for poor learning or behavioral outcomes and data-based decision-making is used to develop and implement evidence-based interventions targeted to students' strengths and needs. Student progress is monitored regularly and adjustments are made to the intensity and nature of an intervention depending on a student's responsiveness and progress toward preidentified goals. This multistage model has been referred to as a response to intervention framework (i.e., RtI) and the adoption of this school-wide reform model has been linked to favorable school climate and constructive discipline strategies (Jimerson, Burns, & VanderHeyden, 2007; Shinn, & Walker, 2010), to reductions in suspensions and expulsions, and to increased learning in academically and behaviorally at risk students (Walker & Gresham, this volume). Positive outcomes associated with this approach have been reported for students with mild impairments and disabilities as well as those with high levels of ability and talent (Gettinger et al., this volume).

Future Systemic Efforts to Improve Education

Competent teachers have been and will continue to be in great demand in the future which will fuel the need for research on sound pedagogy and teacher preparation (National Research Council, 2010; Whitcomb, this volume). Future work by educational psychologists will merge ongoing research on student and classroom learning with initial teacher preparation and continued professional development (Whitcomb, 2010). Effective teachers know how to elicit interest and sustained motivation when learning gets difficult and also how to connect our learning to the real world. They also have the uncanny ability to create a sense of community in the classroom that fosters self- as well as collaborative learning and discovery (Goldman et al., this volume). Researchers in the field will continue to carefully study the characteristics of good teaching and supportive teachers. Future researchers will continue to investigate how to intentionally improve teachers' ability to foster interpersonal connections, self-regulated strategy use, and motivation (Sabol & Pianta, this volume). The search for effective educational interventions also will continue with more credible, well-controlled research designs (Murnane & Willett, 2011). This work will improve consumers' ability to make more informed judgments about educational reforms and innovations. While considerable progress has been made regarding effective interventions, the next great challenge is the need to ensure that such EBI practices become more evident in the daily operation of schools. This is particularly critical for students with special behavior or learning needs (Frey, Lingo, & Nelson, 2010; Walker et al., 2004). However, the current pressure on teachers to cover a certain amount of content in a fixed period of time may not foster the individual or classroom interventions recommended by our authors (Bliss, Skinner, Hautau, & Carroll, 2008; McCormick et al., this volume). Clearly, knowing what works also must be combined with the will to support reforms that incorporate evidence-based practice (Gresham, 2009, 2010) in order to shorten the traditional lag that exists between the development and adoption of innovations (McCombs, 2009; Rogers, 1995). Thus, future educational psychology researchers will not only focus on how to nurture critical learning skills and attributes but also how to influence systemic school-wide reform and promote research-based educational policy (Duffy, Miller, Parsons, & Meloth, 2009; McCombs, this volume).

FINAL CONCLUSIONS

In this chapter, we synthesized seven areas of continued research progress consistently noted by the contributors to the second edition of Volume 7 of the *Handbook of Psychology*. It is clear from our synthesis that the field of educational psychology continues to be, as Witrock proclaimed in 1992, "a vibrant, constantly evolving field focused on some of the most complex, intellectually challenging, and socially significant issues of our time." We also agree with McCombs (this volume) who asserts that the field of educational psychology is an "applications-driven science" that can help address critical issues and problems facing educators today. Educational psychology researchers use high standards of evidence and a wide range of methodologiesto study critical individual and contextual variables within home, school, and community settings. Their work has uncovered important individual differences and universalities concerning human potential and performance and has deepened our understanding of learning, motivation, and development and the contexts and conditions under which they prosper (McCombs, 2003). Major progress has been made; however, there is a need for complementary and converging approaches to examine and solve educational problems (Shavelson & Towne, 2002): what Pearson and Cervetti (this volume) have labeled as "complementarity of methods" to ensure that essential, evidenced-based innovations and practices studied by educational psychologists are more widely disseminated and instituted in the future. Economic, ideological, and political shifts in education are commonplace and likely to continue. However, the work of educational psychologists is uniquely situated to uncover and influence new modes of learning, thinking, and interacting within our constantly evolving educational contexts. The general consensus voiced by our contributors about where the field might be in another decade when the third version of this handbook is likely to be published aligned closely with those expressed in an outgoing presidential address given to members of the American Educational Research Association. In this address, Dr. Alexander (2004) predicted that the important empirical contributions of educational psychologists will increasingly be used to develop unified and valid solutions to problems in education. Calfee (2006) also recently envisioned that educational psychologists will play an even greater role in addressing significant 21st-century educational challenges and improving schooling outcomes for all children. We agree wholeheartedly, and believe that the theories, methodological innovations, and findings of educational psychologists will continue to contribute to significant advances in instruction, curriculum, assessment, evaluation, and teacher professional development that will transform and inspire educational practice and policies well into the future.

REFERENCES

Alexander, P. A. (2004). In the year 2020: Envisioning the possibilities for educational psychology. *Educational Psychologist, 39,* 149–156.

Alexander, P. A., & Winne, P. H. (Eds.). (2006). *Handbook of educational psychology* (2nd ed.). Mahwah, NJ: Erlbaum.

Amsel, E., & Smalley, J. D. (2001). Beyond really and truly: Children's counterfactual thinking about pretend and possible worlds. In P. Mitchell & K. J. Riggs (Eds.), *Children's reasoning and the mind* (pp. 121–147). Hove, UK: Taylor & Francis.

Anderman, E. M., & Anderman, L. H. (2010). *Classroom Motivation*. Upper Saddle River, NJ: Pearson.

Anderman, E. M., Gray, D., & Chang, Y. (this volume). Motivation and classroom learning. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Azevedo, R., & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students' learning with hypermedia? *Journal of Educational Psychology, 96*(3), 523–535.

Ball, D. L., Sleep, L., Boerst, T. A., & Bass, H. (2009). Combining the development of practice and the practice of development in teacher education. *Elementary School Journal, 109*(5), 458–474.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5), 389–407.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development, 6.Six theories of child development* (pp. 1–60). Greenwich, CT: JAI Press.

Banks, J., Cochran-Smith, M., Moll, L., Richert, A., Zeichner, K., LePage, P., . . . McDonald, M. (2005). Teaching diverse learners. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 232–274). San Francisco, CA: Jossey-Bass.

Berliner, D. C. (2006). Educational psychology: Searching for essence throughout a century of influence. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of educational psychology* (2nd ed., pp. 3–27). Mahwah, NJ: Erlbaum.

Black, J. B. (2010). An embodied/grounded cognition perspective on educational technology. In M. S. Khine & I. Saleh (Ed.), *New science of learning: Cognition, computers and collaboration in education.* New York, NY: Springer.

Bliss, S. L., Skinner, C. H., Hautau, B., & Carroll, E. E. (2008). Articles published in four school psychology journals from 2000 to 2005: An analysis of experimental/intervention research. *Psychology in the Schools, 45,* 483–498.

Borko, H., & Putnam, R. (1996). Learning to teach. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 673–708). New York, NY: Macmillan.

Borko, H., Whitcomb, J., & Byrnes, K. (2008). Research genres in teacher education. In M. Cochran-Smith, S. Feiman-Nemser, and D. J. McIntyre (Eds.) *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 1017–1049). New York, NY: Routledge.

Bransford, J., Derry, S., Berliner, D., & Hammerness, K. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do,* pp. 40–87. San Francisco, CA: Jossey-Bass.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U. (1989). Ecological systems theory. In R. Vasta (Ed.), *Annals of Child Development* (Vol. 6, pp. 187–250). Greenwich, CT: JAI.

Brown, J. S., Collins, A., & Duguid, P. (1996/1989). Situated cognition and the culture of learning. In H. McLellan (Ed.), *Situated learning perspectives*. Englewood Cliffs, NJ: Educational Technology.

Bruder, M. B. (2010). Early childhood intervention: A promise to children and families for their future. *Exceptional Children, 76,* 339–355.

Burchinal, M., Vandergrift, N., Pianta, R., & Mashburn, A. (2010). Threshold analysis of association between child care quality and child outcomes for low-income children in pre-kindergarten programs. *Early Childhood Research Quarterly, 25*(2), 166–176.

Calfee, R. C. (2006). Educational psychology in the 21st century. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of educational psychology II* (pp. 29–42). Mahway, NJ: Erlbaum.

Carr, M. (2010). The importance of metacognition for conceptual change and strategy use in mathematics. In H. S. Waters & W. Schneider (Eds.), *Metacognition, strategy use, and instruction* (pp. 177–197). New York, NY: Guilford Press.

Chazan, D., & Yerushalmy, M. (1998). Charting a course for secondary geometry. In R. Lehrer & D. Chazan (Eds.), *Designing learning* *environments for developing understanding of geometry and space* (pp. 67–90). Mahwah, NJ: Erlbaum.

Christenson, S. L., & Reschly, A. (Eds.). (2010). *Handbook of school-family partnerships*. New York, NY: Routledge.

Cochran-Smith, M., & Lytle, S. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education, 24,* 249–305.

Cochran-Smith, M., & Fries, M. K. (2005). Researching teacher education in changing times. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA Panel on research and teacher education* (pp. 69–109). Mahwah, NJ: Erlbaum.

Collignon, F. F. (1994). From "Paj Ntaub" to paragraphs: Perspectives on Hmong processes of composing. In V. John-Steiner, C. P. Panofsky, & L. W. Smith (Eds.), *Sociocultural approaches to language and literacy*: *An interactionist perspective* (pp. 331–346). New York, NY: Cambridge University Press.

Cooper, R., & Slavin, R. E. (2004). Cooperative learning: An instructional strategy to improve intergroup relations. In W. G. Stephan & W. P. Vogt (Eds.), *Education programs for improving intergroup relations.* New York, NY: Teachers College Press.

Curtis, M. J., Castillo, J. M., & Cohen, R. M. (2008). Best practices in system-level change. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 887–901). Bethesda, MD: National Association of School Psychologists.

Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L., & Bransford, J. (Eds.) (2005). *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco, CA: Jossey-Bass.

Dasen, P. (1984). The cross-cultural study of intelligence. *International Journal of Psychology, 19,* 407–434.

Deno, S. (2005). Problem-solving assessment. In R. Brown-Chidsey (Ed.), *Assessment for intervention: A problem-solving approach* (pp. 10–40). New York, NY: Guilford Press.

Derry, S., Levin, J. R., Osana, H. P., Jones, M. S., & Peterson, M. (2000). Fostering students' statistical and scientific thinking: Lessons learned from an innovative college course. *American Educational Research Journal, 37,* 747–773.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review, 20,* 391–409.

di Sessa, A. (2000). *Changing minds: Computers, learning, and literacy.* Cambridge, MA: MIT Press.

Dowson, M., & McInerney, D. M. (2003). What do students say about their motivational goals?: Towards a more complex and dynamic perspective on student motivation. *Contemporary Educational Psychology, 28,* 91–113.

Duffy, G. G., Miller, S., Parsons, S., & Meloth, M. (2009). Teachers as metacognitive professionals. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 240–256). New York, NY: Routledge.

Ehri, L. (1999). Phases of development in learning to read words. In J. Oakhill & R. Beard (Eds.), Reading development and the teaching of reading: A psychological perspective (pp. 79–108). Oxford, United Kingdom: Blackwell.

Ehri, L. (2005). Learning to read words: Theory, findings and issues. *Scientific Studies of Reading, 9,* 167–188.

Ervin, R. A., & Schaughency, E. (2008). Best practices in accessing the systems change literature. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 853–874). Bethesda: MD: National Association of School Psychologists.

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103* (6), 1013–1055.

Fisher, K. R., Marshall, P. J., & Nanayakkara, A. R. (2009). Motivational orientation, error monitoring, and academic performance in middle childhood: A behavioral and electrophysiological investigation. *Mind, Brain, and Education, 3* (1), 56–63.

Frey, A., Lingo, A., & Nelson, M. (2010). Implementing positive behavior support in elementary schools. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI.* Bethesda: National Association of School Psychologists, 397–434.

Gettinger, M., Brodhagen, E., Butler, M., & Schienebeck, C. (this volume). School psychology. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Goldman-Segall, R. (1996). Genderflexing: A theory of gender and socio-scientific thinking, *Proceedings for the International Conference on the Learning Sciences*. Chicago, IL.

Goldman-Segall, R. (1998). *Points of viewing children's thinking: A digital ethnographer's journey*. Mahwah, NJ: LEA. Interactive video cases available at www.pointsofviewing.com/

Goldman, R., Black, J., Maxwell, J. W., Plass, J. J. L., & Keitges, M. (this volume). Towards interactive digital media technologies for learning: The points of viewing theory. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Goldman, R., Crosby, M., Swan, K., & Shea, P. (2004). Introducing quisitive research: Expanding qualitative methods for describing learning in ALN. In R. Starr Hiltz & R. Goldman (Eds.), *Learning together online: Research on asynchronous learning networks*. Mahwah, NJ: LEA.

Goldman, R., Pea, R. D., Barron, B., & Derry, S. (Eds.) (2007). *Video research in the learning sciences.* Mahwah, NJ: LEA.

Greene, J. A., & Azevedo, R. (2010). The measurement of learners self-regulated cognitive and metacognitive processes while using computer-based learning environments. *Educational Psychologist, 45* (4), 203–209.

Greenfield, P. M., Trumbull, E., Keller, H., Rothstein-Fisch, C., Suzuki, L., & Quiroz, B. (2006). Cultural conceptions of learning and development. In P. A. Alexander & P. H. Winne (Eds.) *Handbook of educational psychology II* (pp. 675–692). Mahway, NJ: Erlbaum.

Gresham, F. M., (2009). Evolution of the treatment integrity concept: Current status and future directions. *School Psychology Review, 38* (4), 533–540.

Gresham, F. M. (2010). Evidence-based social skills interventions: Empirical foundations for instructional approaches. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 337–362). Bethesda, MD: National Association of School Psychologists.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and teaching: Theory and practice, 15* (2), 273–289.

Hamre, B. K., & Pianta, R. C. (2005). Can instructional and emotional support in the first grade classroom make a difference for children at risk of school failure? *Child Development, 76,* 949–967.

Harel, I., & Papert, S. (1991). *Constructionism.* Norwood, NJ: Ablex.

Hintze, J. M., Christ, T. J., & Methe, S. A. (2006). Curriculum-based assessment. *Psychology in the Schools, 43* (1), 45–56.

Hollins, E. R., & Torres Guzman, M. (2005). Research on preparing teachers for diverse populations. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA panel on research and teacher education* (pp. 477–544). Mahwah, NJ: Erlbaum.

Hsieh, P. H., Acee, T., Chung, W. -H., Hsieh, Y. P., Kim, H., Thomas, G. D., . . . Robinson, D. H. (2005). Is educational intervention research on the decline? *Journal of Educational Psychology, 97,* 523–529.

Hughes, J. N., Luo, W., Kwok, O. M., & Loyd, L. K. (2008). Teacher-student support, effortful engagement, and achievement: A 3-year longitudinal study. *Journal of Educational Psychology, 100*(1), 1–14.

Jacobson, C., & Lehrer, R. (2000). Teacher appropriation and student learning of geometry through design. *Journal for Research in Mathematics Education, 31,* 71–88.

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It's not autonomy support or structure, but autonomy support and structure. *Journal of Educational Psychology, 102,* 588–600.

Jimerson, S. R., Burns, M. K., & VanderHeyden, A. M. (Eds.) (2007). *Handbook of response to intervention: The science and practice of assessment and intervention.* New York, NY: Springer.

John-Steiner, V. (1995). Cognitive pluralism: A sociocultural approach. *Mind, Culture, and Activity, 2*(1), 2–10.

John-Steiner, V. (2000). *Creative collaboration.* New York, NY: Oxford University Press.

John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A Vygotskian framework. *Educational Psychologist, 31*(3/4), 191–206.

John-Steiner, V., & Mahn, H. (2003). Sociocultural contexts for teaching and learning. In W. M. Reynolds & G. E. Miller (Eds.), Educational Psychology (pp. 125–152). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology*. Hoboken, NJ: Wiley.

Joshi, A. (2009). What do teacher-child interactions in early childhood classrooms in India look like? Teachers' and parents' perspectives. *Early Child Development and Care, 1,* 1–19.

Jussim, L., Robustelli, S., & Cain, T. (2009). Teacher expectations and self-fulfilling prophecies. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 349–380). New York, NY: Taylor Francis.

Kamil, M., Pearson, P. D., Moje, E., & Afflerbach, P. (Eds.). (2011). *Handbook of reading research* (Vol. 4). London, UK: Routledge.

Kelly, A., & Lesh, R. (Eds.) (2000). *The handbook of research design in mathematics and science education* (pp. 591–646). Hillsdale, NJ: Erlbaum.

Khortagen, F. (2010). Situative learning theory and the pedagogy of teacher education: Towards an integrative view of teacher behavior and teacher learning. *Teaching and teacher education, 26,* 98–106.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge, UK: Cambridge University Press.

Kintsch, W. (2004). The construction-integration model of text comprehension and its implications for instruction. In R. B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading*. Newark, DE: International Reading Association.

Koskey, K. L., Karabenick, S. A., Woolley, M. E., Bonney, C. R., & Dever, B. V. (2010). Cognitive validity of students' self-reports of classroom mastery goal structure: What students are thinking and why it matters. *Contemporary Educational Psychology, 35,* 254–263.

Laible, D., & Thompson, R. A. (2007). Early socialization: A relationship perspective. In J. Grusec & P. Hastings (Eds.), *Handbook of Social Development* (pp. 181–207). New York, NY: Guilford Press.

Lantolf, J. P., & Beckett, T. G. (2009). Research timeline: Sociocultural theory and second language acquisition. *Journal of Language Teaching, 42*(4), 459–475.

Lapsley, D., & Yeager, D. (this volume). Moral-charater education. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Lee, K., Karmiloff-Smith, A., Cameron, C. A., & Dodsworth, P. (1998). Notational adaptation in children. *Canadian Journal of Behavioural Science, 30,* 159–171.

Lehrer, R., Kim, M., & Schauble, L. (2007). Supporting the development of conceptions of statistics by engaging students in modeling and measuring variability. *International Journal of Computers for Mathematics Learning, 12,* 195–216.

Lehrer, R. & Lesh, R. (this volume). Mathematical learning. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Lehrer, R., & Schauble, L. (2000). Modeling in mathematics and science. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 101–159). Mahwah, NJ: Erlbaum.

Lehrer, R., & Schauble, L. (2005). Developing modeling and argument in elementary grades. In T. A. Romberg, T. P. Carpenter, & F. Dremock (Eds.), *Understanding mathematics and science matters* (pp 29–53). Mahwah, NJ: Erlbaum.

Lehrer, R., & Schauble, L. (2007). A developmental approach for supporting the epistemology of modeling. In W. Blum, P. L. Galbraith, H. W. Henn, & M. Niss (Eds.), *Modeling and applications in mathematics education* (pp. 153–160). New York, NY: Springer.

Lesh, R. (2002). Research design in mathematics education: Focusing on design experiments. In L. English (Ed.), *The international handbook of research design in mathematics education* (pp. 241–287). Hillsdale, NJ: Erlbaum.

Levin, J. R. (1994). Crafting educational intervention research that's both credible and creditable. *Educational Psychology Review, 6,* 231–243.

Levin, J. R. (2004). Random thoughts on the (in)credibility of educational-psychological intervention research. *Educational Psychologist, 39,* 173–184.

Levin, J. R., & O'Donnell, A. M. (1999). What to do about educational research's credibility gaps? *Issues in Education: Contributions from Educational Psychology, 5,* 177–229.

Levin, J. R., & Kratochwill, T. R. (this volume). Educational psychological intervention research circa 2011. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Lima, E. (1998). The educational experience with the Tikuna: A look into the complexity of concept construction. *Mind, Culture, and Activity, 5*(2), 95–104.

Lines, C., Miller, G. L., & Arthur-Stanley, A. (2011). *The power of family-school partnering (FSP): A practical guide for school mental health professionals and educators.* New York, NY: Routledge.

Lord, R. G., Diefendorff, J. M., Schmidt, A. M., & Hall, R. J. (2010). Self-regulation at work. *Annual Review of Psychology, 61,* 543–568.

Mahn, H., & John-Steiner, V. (2005). Vygotsky's contribution to literacy research. In R. Beach, J. L. Green, M. L. Kamil, & T. Shanahan (Eds.) *Multidisciplinary perspectives on literacy research* (2nd ed.). Urbana, IL: National Council of Teachers of English.

Mahn, H., & John-Steiner, V. (this volume). Vygotsky and sociocultural approaches to teaching and learning. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

McCombs, B. L. (this volume). Educational psychology and educational transformation. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

McCombs, B. L. (2003). Research to policy for guiding educational reform. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* (pp. 583–608). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology*. Hoboken, NJ: Wiley.

McCombs, B. L. (2009). Commentary: What can we learn from a synthesis of research on teaching, learning, and motivation? In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school*. New York, NY: Routledge.

McCombs, B. L., & Miller, L. (2007). *Learner-centered classroom practices and assessments: Maximizing student motivation, learning, and achievement.* Thousand Oaks, CA: Corwin Press.

McCombs, B. L., & Miller, L. (2008). *The school leader's guide to learner-centered education: From complexity to simplicity.* Thousand Oaks, CA: Corwin Press.

McCormick, C. B., Dimmitt, C., & Sullivan, F. R. (this volume). Metacognition and classroom learning. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Miller, G. E., & Reynolds, W. M. (Eds.). (2003). Future perspective in educational psychology. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* (pp. 609–630). Vol. 7 in I. B. Weiner (Editor-in-Chief), *Handbook of psychology*. Hoboken, NJ: Wiley.

Murayama, K., & Elliot, A. J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology, 101,* 432–444.

Murnane, R. J., & Willett, J. B. (2011). *Methods matter: Improving causal inference in educational and social science research*. New York, NY: Oxford University Press.

Murphy, P. K., Wilkinson, I. A. G., Soter, A. O., Hennessey, M. N., & Alexander, J. F. (2009). Examining the effects of classroom discussion on students' high-level comprehension of text: A meta-analysis. *Journal of Educational Psychology, 101,* 740–764.

Narvaez, D., & Lapsley, D. K. (2005). The psychological foundations of everyday morality and moral expertise. In D. K. Lapsley & F. C. Power (Eds.), *Character psychology and character education* (pp. 140–165). Notre Dame, IN: University of Notre Dame Press.

National Research Council. (2010). *Preparing teachers: Building evidence for sound policy*. Washington, DC: National Academies Press.

Neihart, M. (2007). The socioaffective impact of acceleration and ability grouping: Recommendations for best practice. *Gifted Child Quarterly, 51,* 330–341.

Newcombe, N. S., & Huttenlocher, J. (2000). *Making space.* Cambridge, MA: MIT Press.

Oakhill, J., Cain, K., & Bryant, P. (2003). The dissociation of word reading and text comprehension: Evidence for component skills. *Language and Cognitive Processes*, *18*, 443–468.

O'Donnell, A. M., & Levin, J. R. (2001). Educational psychology's healthy growing pains. *Educational Psychologist, 36,* 73–82.

Ogbu, J. U. (1985). Origins of human competence: A cultural-ecological perspective. *Child Development, 52,* 413–429.

Olszewski-Kubilius, P., & Thomson, D. (2010). Gifted programming for poor or minority urban students: Issues and lessons learned. *Gifted Child Today, 33*(4), 58–65.

Olszewski-Kubilius, P., & Thomson, D. (this volume). Gifted education programs and procedures. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7. In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Patall, E., Cooper, H., & Wynn, S. P. (2010). The effectiveness and relative importance of choice in the classroom. *Journal of Educational Psychology, 102*(4), 896–915.

Pea, R., Bransford, J. D., Brown, A., & Cocking, R. (2000). (Eds.). How people learn: Brain, mind, experience, and school. Washington, DC: National Academy Press.

Peacock, G. G., & Collett, B. R. (2010). *Collaborative home/school interventions: Evidence-based solutions for emotional, behavioral, and academic problems.* New York, NY: Guilford Press.

Pearson, P. D., & Cervetti, G. (this volume). The psychology and pedagogy of reading processes. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Pianta, R. C., Hamre, B., & Stuhlman, M. (2003). Relationships between teachers and children. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* (pp. 299–234). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Sabol, T. & Pianta, R. C. (this volume). Relationships between teachers and children. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Pianta, R. C., & Stuhlman, M. W. (2004). Teacher-child relationships and children's success in the first years of school. *School Psychology Review, 33,* 444–458.

Pintrich, P. R. (2003). Motivation and classroom learning. In G. E. Miller & W. M. Reynolds (Eds.), *Educational psychology* (pp. 101–122). Vol. 7 in I. B. Weiner (Editor-in-Chief), *Handbook of psychology*. Hoboken, NJ: Wiley.

Plass, J. L., Homer, B. D., & Hayward, E. (2009). Design factors for educationally effective animations and simulations. *Journal of Computing in Higher Education, 21*(1), 31–61.

Plomin, R., DeFries, J. C., McClearn, G. E., & McGuffin, P. (2008). *Behavioral genetics.* New York, NY: Worth.

Pressley, M. G. (2003). Psychology of literacy and literacy instruction. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* (pp. 333–356). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Pressley, M. G. (2005). "Oh the places an Educational Psychologist can Go! . . . and how young educational psychologists can prepare for the trip (apologies to Dr. Seuss)." *Educational Psychologist, 40,* 137–153.

Pressley, M. G. (2006). *Reading instruction that works: The case for balanced teaching*. New York, NY: Guilford Press.

Reynolds, W. M., & Miller, G. E. (2003). Current perspectives in educational psychology. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* (pp. 3–20). Vol. 7 in I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Reynolds, W. M., & Miller, G. E. (this volume). Current perspectives in educational psychology. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology.* Hoboken, NJ: Wiley.

Rogers, E. (1995). *Diffusion of innovations* (4th ed.). London, UK: Free Press.

Rose, E. R. (2010). *The promise of preschool: From Head Start to universal pre-kindergarten*. Oxford, UK: Oxford University Press.

Rosen, L. D. (2011). Teaching the iGeneration. *Educational Leadership, 68*(5), 10–15.

Ruddell, R. B., & Unrau, N. J. (Eds.). (2004). *Theoretical models and processes of reading* (5th ed.). Newark, DE: International Reading Association.

Ryan, R. M., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: Does psychology need choice, self-determination, and will? *Journal of Personality, 74,* 1557–1586.

Schmittau, J. (2004). Vygotskian theory and mathematics education: Resolving the conceptual-procedural dichotomy. *European Journal of Psychology of Education, 19*(1), 19–43.

Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334–370). New York, NY: Macmillan.

Schunk, D. H., & Pajares, F. (2009). Self-efficacy theory. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 35–53). New York, NY: Routledge.

Schunk, D. H., & Zimmerman, B. J. (1998). *Self-regulated learning: From teaching to self-reflective practice.* New York, NY: Guilford Press.

Schunk, D. H., & Zimmerman, B. J. (Eds.). (2008). *Motivation and self-regulated learning: Theory, research, and applications.* New York, NY: Taylor & Francis.

Schunk, D. H., & Zimmerman, B. J. (this volume). Self-regulation and learning. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ: Wiley.

Serpell, R. (1993). *The significance of schooling: Life journeys in an African society.* New York, NY: Cambridge University Press.

Shanahan, T., Callison, K., Carriere, C., Duke, N. K., Pearson, P. D., Schatschneider, C., & Torgesen, J. (2010). *Improving reading comprehension in kindergarten through 3rd grade: A practice guide* (NCEE 2010–4038). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. whatworks.ed.gov/publications/practiceguides

Shavelson, R. J., & Towne, L. (Eds.). (2002). *Scientific research in education*. Washington, DC: National Academy Press.

Sheridan, S. M., Taylor, A. M., & Woods, K. E. (2008). Best practices for working with families: Instilling a family-centered approach. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 995–1008). Bethesda, MD: National Association of School Psychologists.

Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (Eds.). (2011). *Mathematics teacher noticing: Seeing through teacher's eyes*. New York, NY: Routledge.

Shinn, M. R. (2010). Building a scientifically based data system for progress monitoring and universal screening across three tiers, including RTI using curriculum-based measurement. In M. R. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 259–292). Bethesda, MD: National Association of School Psychologists.

Shinn, M. R., & Walker, H. (Eds.) (2010). *Interventions for achievement and behavior problems in a three-tier model including RTI.* Bethesda, MD: National Association of School Psychologists.

Slavin, R. E. (this volume). Cooperative learning and achievement: Theory and research. In W. M. Reynolds & G. E. Miller (Eds.), *Educational Psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ: Wiley.

Snowling, M., & Hulme, C. (Eds). (2005). *The science of reading: A handbook*. Oxford, UK: Blackwell.

Squires, J., Pribble, L., Chen, C., & Pomes, M. (this volume). Early childhood education: Improving outcomes for young children and families. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ: Wiley.

Stahl, S. A., & Stahl, K. A. (2004). Word wizards all!: Teaching word meanings in preschool and primary education. In J. F. Baumann & E. J. Kame'enui (Eds.), *Vocabulary instruction*. New York, NY: Guilford Press.

Sternberg, R. J. (2003). *Wisdom, intelligence, and creativity, synthesized.* New York, NY: Cambridge University Press.

Sternberg, R. J. (this volume). Contemporary theories of intelligence. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ: Wiley.

Sternberg, R. J., & Davis, J. E. (Eds.) (2005). *Conceptions of giftedness. Second edition*. New York, NY: Cambridge University Press.

Sternberg, R. J., & Grigorenko, E. L. (Eds.). (1997). *Intelligence, heredity, and environment.* NewYork, NY: Cambridge University Press.

Taylor, B. M., Pearson, P. D., Peterson, D. S., & Rodriguez, M. C. (2003). Reading growth in high-poverty classrooms: The influence of teacher practices that encourage cognitive engagement in literacy learning. *Elementary School Journal, 104,* 3–28.

Torres-Velásquez, D. (Ed.). (1999). Sociocultural perspectives in special education. *Remedial and Special Education, 20*(6), 321–384.

Torres-Velásquez, D. (Ed.). (2000). Sociocultural perspectives in special education. Part 2. *Remedial and Special Education, 21*(2), 65–128.

van den Broek, P., Young, M., Tzeng, Y., & Linderholm, T. (1998/2004). The landscape model of reading: Inferences and the on-line construction of a memory representation. In H. van Oostendorp & S. R. Goldman (Eds.), *The construction of mental representations during reading* (pp. 71–98). Mahwah, NJ: Erlbaum. Reprinted In R. B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading* (pp. 1244–1269). Newark, NJ: International Reading Association.

VanDerHeyden, A. M., & Burns, M. K. (2005). Using curriculum-based assessment and curriculum-based measurement to guide elementary mathematics instruction: Effects on individual and group accountability scores. *Assessment for Effective Intervention, 30*(3), 15–31.

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic role of intrinsic goals and autonomy support. *Journal of Personality and Social Psychology, 87,* 246–260.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1,* 3–14.

Veenman, M. V. J., Wilhelm, P., & Beishuizen, J. J. (2004). The relation between intellectual and metacognitive skills from a developmental perspective. *Learning and Instruction, 14,* 89–109.

Villegas, A. M. (2007). Dispositions in teacher education. *Journal of Teacher Education, 58*(5), 370–380.

Vrugt, A., & Oort, F. J. (2008). Metacognition, achievement goals, study strategies and academic achievement: Pathways to achievement. *Metacognition and Learning, 30,* 123–146.

Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Walker, H. M., & Gresham, F. M. (this volume). In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ: Wiley.

Walker, H. M., Ramsey, E., & Gresham, F. M. (2004). *Antisocial behavior in school: Evidence-based practices.* Belmont, CA: Wadsworth/Thomson Learning.

Walker, H. M., Severson, H., & Seeley, J. (2010). Universal, school-based screening for the early detection of behavioral problems contributing to later destructive outcome. In M. Shinn & H. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 677–702). Bethesda, MD: National Association of School Psychologists.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, UK: Cambridge University Press.

Wentzel, K. R. (2009). Students' relationships with teachers as motivational contexts. In K. Wentzel and A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 301–322). Mahwah, NJ: LEA.

Wentzel, K. R. (2010). Teacher-student relationships. In J. Meece and J. Eccles (Eds.), *Handbook on schooling and development*. Mahwah, NJ: LEA.

Wentzel, K. R. (this volume). School adjustment. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology.* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ Wiley.

Wentzel, K. R., & Looney, L. (2007). Socialization in school settings. In J. Grusec & P. Hastings (Eds.), *Handbook of social development* (pp. 382–403). New York, NY: Guilford Press.

Wentzel, K. R., & Watkins, D. E. (2010). Peer relationships and learning: Implications for instruction. In R. Mayer and P. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 322–343). New York, NY: Routledge.

What Works Clearinghouse. (2008). *Procedures and standards handbook* (Version 2.0). http://ies.ed.gov/ncee/wwc/pdf/wwc_version1_standards.pdf

Whitcomb, J. (2010). Conceptions of teacher education. In Penelope Peterson, Eva Baker, & Barry McGaw, (eds). *The international encyclopedia of education* (Vol. 7, pp. 598–603). Oxford, UK: Elsavier.

Whitcomb, J. (this volume). Learning and pedagogy in initial teacher preparation. In W. M. Reynolds & G. E. Miller (Eds.), *Educational psychology* Vol. 7 In I. B. Weiner (Ed.-in-Chief), *Handbook of psychology* (2nd ed.). Hoboken, NJ: Wiley.

Winne, P. (2010). Improving measurements of self-regulated learning. *Educational Psychologist, 45*(4), 267–276.

Winne, P. H., & Hadwin, A. F. (2008). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 297–314). New York, NY: Taylor & Francis.

Wittrock, M. C. (1992). An empowering conception of educational psychology, *Educational Psychologist, 27,* 139–141.

Wittrock, M. C., & Farley, F. L. (1989). Toward a blueprint for educational psychology. In M. C. Witrock & F. L. Farley (Eds.), *The future of educational psychology* (pp. 193–199). Hillsdale, NJ: Erlbaum.

Yang, S., & Sternberg, R. J. (1997). Conceptions of intelligence in ancient Chinese philosophy. *Journal of Theoretical and Philosophical Psychology, 17*(2), 101–119.

Zimmerman, B., & Cleary, T. (2009). Motives to self-regulate learning: A social cognitive account. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 247–264). New York, NY: Taylor Francis.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). San Diego, CA: Academic Press.

Author Index

Subject Index