

Learning Theories An Educational Perspective 8th Edition PDF

Visit the link below to download the full version of the ebook

[DOWNLOAD NOW](#)

LEARNING THEORIES

An Educational
Perspective

EIGHTH EDITION



Dale S



Scan to Download
or Type the Link

ebook.ac/learning8e

LEARNING THEORIES

An Educational
Perspective

EIGHTH EDITION



Dale Schunk

Learning Theories

An Educational Perspective

Eighth Edition

Dale H. Schunk

The University of North Carolina at Greensboro



Director and Publisher: Kevin M. Davis
Content Producer: Janelle Rogers
Media Producer: Lauren Carlson
Portfolio Management Assistant: Casey Coriell
Executive Field Marketing Manager: Krista Clark
Executive Product Marketing Manager: Christopher Barry
Procurement Specialist: Carol Melville
Full-Service Project Management: Thistle Hill Publishing Services, LLC
Cover Designer: Carie Keller, Pearson CSC
Cover Image: Tom Gril / JGI / Blend Images / Getty Images
Composition: Pearson CSC
Printer/Binder: LSC Communications, Inc. / Crawfordsville
Cover Printer: Phoenix Color/Hagerstown
Text Font: 10/12 ITC Garamond Std

Credits and acknowledgments borrowed from other sources and reproduced, with permission, in this textbook appear on the appropriate page within the text.

Every effort has been made to provide accurate and current Internet information in this book. However, the Internet and information posted on it are constantly changing, so it is inevitable that some of the Internet addresses listed in this textbook will change.

Copyright © 2020, 2016, 2012 by Pearson, Inc., 221 River Street, Hoboken, NJ 07030. All rights reserved. Printed in the United States of America. This publication is protected by Copyright, and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. To obtain permission(s) to use material from this work, please visit <http://www.pearsoned.com/permissions/>

Library of Congress Cataloging-in-Publication Data

Names: Schunk, Dale H., author.

Title: Learning theories : an educational perspective / Dale H. Schunk, The University of North Carolina at Greensboro.

Description: Eighth Edition. | New York, NY : Pearson, [2018] | Includes bibliographical references and index.

Identifiers: LCCN 2018034999 | ISBN 9780134893754 (paperback) | ISBN 0134893751 (paperback)

Subjects: LCSH: Learning. | Cognition. | Learning, Psychology of.

Classification: LCC LB1060 .S37 2018 | DDC 370.15/23—dc23

LC record available at <https://lcn.loc.gov/2018034999>

10 9 8 7 6 5 4 3 2 1



ISBN 13: 978-0-13-489375-4
ISBN 10: 0-13-489375-1

Dedication

*To Albert Bandura, for helping me develop self-efficacy
for leading a fulfilling life*

Preface

Learning is a lifelong activity and fundamental to education. And the study of learning is crucial for everyone who wants to live a fulfilling life and help others do so. The better we understand learning, the better we can determine how to improve it.

Over the past several years, the study of learning by researchers has continued at a strong pace. This situation is desirable because it has resulted in theoretical refinements, improved research methodologies, and implications for instruction based on sound theory and research.

Although the study of learning has changed a lot since the first edition of this book was published in 1991, the primary objectives of this eighth edition remain much the same as those of the first edition: (a) to help students become knowledgeable of learning theoretical principles, concepts, and research findings, especially as they relate to education, and (b) to provide applications of principles and concepts in settings where teaching and learning occur. As in previous editions, the focus of the current edition is on cognition. Cognitive constructivist perspectives emphasize that learners are not passive recipients of information but rather actively seek, construct, and adapt their knowledge, skills, strategies, and beliefs.

STRUCTURE OF THIS TEXT

The text's 12 chapters are organized as follows. The introductory chapter covers learning theory, research methods, and learning issues, as well as historical foundations of the study of learning. Chapter 2 discusses the neuroscience of learning. A basic understanding of neuroscience assists readers in understanding the links between brain functions and cognitive and constructivist learning principles. Chapter 3 covers behaviorism, a dominant learning theory for many years. Current cognitive and constructivist theories and principles are the subject of Chapters 4–8: social cognitive theory; information processing theory—encoding and storage; information processing theory—retrieval and forgetting; cognitive learning processes; and constructivism. Chapters 9–11 cover topics relevant to and integrated with learning: motivation, self-regulated learning, and contextual influences. The final chapter asks learners to develop their own perspective on learning.

NEW TO THIS EDITION

Readers familiar with prior editions will notice content and organizational changes in this edition, which reflect new theoretical and research emphases. Several topics have been added including sections on educational data mining, positive behavior supports,

metacognition and epistemic thinking, Neo-Piagetian theories, self-regulation and technology, and future developments in the study of learning. The text has been revised to incorporate newer theoretical principles and research findings. These revisions are most evident in the chapters on constructivism and contextual influences. Sections on technology throughout the text have been revised to keep up with the latest educational uses of technology. Added to the ends of each of the first eleven chapters are two new sections: a chapter critique and a set of reflection questions that students can think about as they review the chapter and can be discussed in classes. To keep the text current and timely, new terms have been incorporated into the glossary. More than 200 new references have been added, and several dated references have been dropped.

Applications of learning principles have been a hallmark of this text since its inception and these continue to be present in this new edition. Each chapter except the introductory and concluding chapters contains a section on instructional applications. All chapters begin with vignettes that illustrate some principles discussed in the chapters. Throughout the chapters, there are many informal examples and detailed applications. Most of the applications involve K–12 settings, but applications also address other learning contexts including college students.

The text is designed for graduate students in education or related disciplines, as well as upper-level undergraduates interested in education. It is assumed that most students have taken a course in education or psychology and currently work in an educational capacity or anticipate pursuing an educational career. The text is appropriate for courses on learning and cognition, as well as any course that covers learning in some depth such as courses on motivation, educational psychology, human development, and instructional design.

ACKNOWLEDGEMENTS

Many people deserve thanks for their contributions to this edition. Over many years, there have been numerous professional colleagues who have assisted me to develop my thinking about learning processes and applications. I have acknowledged the contributions of these individuals in previous editions. For this edition, I want to gratefully thank Héfer Bembenutty, Herb Clark, Maria DiBenedetto, Jeff Greene, Judith Meece, Ellen Usher, Bernard Weiner, Allan Wigfield, Phil Winne, and Barry Zimmerman. My association with members of professional organizations has been most beneficial, especially the Motivation in Education and the Studying and Self-Regulated Learning Special Interest Groups of the American Educational Research Association, and Division 15 (Educational Psychology) of the American Psychological Association. It has been an honor for me to work with many excellent students, teachers, counselors, administrators, and superintendents. I also am indebted to several graduate and undergraduate student collaborators who assisted me on research projects.

I am most fortunate that again for this edition my editor at Pearson Education is Kevin Davis. Kevin unquestionably is one of the finest editors anyone could work with. He is highly encouraging and supportive, and his continued guidance has resulted in a better product. I also express appreciation to Casey Coriell and Janelle Rogers at Pearson

Education for their editorial assistance. I owe sincere thanks to the following reviewers of the eighth edition: Oris Griffin, James Madison University; James R. May, Oklahoma State University; Kerry Rice, Boise State University; Melissa Stormont, University of Missouri; and Ellie L. Young, Brigham Young University.

It is hard to believe that it has been almost 30 years since the first edition of this book was published. At that time, I proudly gave a copy to my parents, the late Mil and Al Schunk, for their love, encouragement and support. Since then, several friends have served as inspirations to me to continue to produce new editions. For this edition, I graciously thank Bill Gattis. And I am most grateful for my wife Maria and my daughter Laura, who was born shortly before the first edition was released. Laura is a remarkable young woman from whom I have learned so much and in whose life learning has made a profound difference.

Brief Contents

1	Introduction to the Study of Learning	1
2	Neuroscience of Learning	30
3	Behaviorism	78
4	Social Cognitive Theory	124
5	Information Processing Theory: Encoding and Storage	168
6	Information Processing Theory: Retrieval and Forgetting	216
7	Cognitive Learning Processes	252
8	Constructivism	312
9	Motivation	360
10	Self-Regulated Learning	416
11	Contextual Influences	462
12	Next Steps	508
Glossary	514	
References	527	
Author Index	569	
Subject Index	582	

Contents

1 Introduction to the Study of Learning 1

Learning Defined 3

Precursors of Modern Learning Theories 4

- Learning Theory and Philosophy 5
- Beginnings of the Psychological Study of Learning 7
- Structuralism and Functionalism 8

Learning Theory and Research 11

- Functions of Theory 11
- Conducting Research 11

Assessment of Learning 14

- Direct Observations 16
- Written Responses 16
- Oral Responses 17
- Ratings by Others 17
- Self-Reports 17
- Educational Data Mining 19
- Assessment Issues 20

Relation of Learning and Instruction 21

Critical Issues for Learning Theories 23

- How Does Learning Occur? 24
- How Does Memory Function? 25
- What Is the Role of Motivation? 25
- How Does Transfer Occur? 26
- How Does Self-Regulated Learning Operate? 26
- What Are the Implications for Instruction? 27

Summary and Critique 27

Reflection Questions 29

Further Reading 29

2 Neuroscience of Learning 30

Organization and Structures 32

- Neural Organization 33
- Brain Structures 34
- Localization and Interconnections 38
- Brain Research Methods 40

Neurophysiology of Learning 44

- Information Processing System 44
- Memory Networks 48
- Language Learning 51

Brain Development 52

- Influential Factors 52
- Phases of Development 54
- Sensitive Periods 55
- Language Development 57
- Influence of Technology 60

Motivation and Emotions 61

- Motivation 62
- Emotions 64

Instructional Applications 67

- Relevance of Brain Research 67
- Brain Myths 67
- Educational Issues 68
- Brain-Based Educational Practices 70

Summary and Critique 73

Reflection Questions 77

Further Reading 77

3 Behaviorism 78

Connectionism 80

- Trial-and-Error Learning 80
- Principles of Learning 81
- Thorndike and Education 83

Classical Conditioning	84
Basic Processes	85
Informational Variables	87
Conditioned Emotional Reactions	87
Contiguous Conditioning	89
Acts and Movements	89
Habit Formation and Change	90
Operant Conditioning	93
Conceptual Framework	94
Basic Processes	95
Behavior Change	103
Behavior Modification	105
Contemporary Perspective	107
Instructional Applications	108
Behavioral Objectives	109
Learning Time	111
Mastery Learning	113
Differentiated Instruction	115
Contingency Contracts	118
Summary and Critique	120
Reflection Questions	122
Further Reading	123

4 Social Cognitive Theory 124

Conceptual Framework for Learning	126
Reciprocal Interactions	127
Enactive and Vicarious Learning	128
Learning and Performance	129
Self-Regulation	129
Modeling Processes	130
Theories of Imitation	130
Functions of Modeling	132
Cognitive Skill Learning	135
Motor Skill Learning	137
Influences on Learning and Performance	139
Developmental Status of Learners	139
Model Prestige and Competence	140
Vicarious Consequences to Models	141

Motivational Processes	143
Goals	143
Outcome Expectations	147
Values	149

Self-Efficacy	150
Conceptual Overview	150
Self-Efficacy in Achievement	
Contexts	152
Models and Self-Efficacy	154
Motor Skills	156
Teacher Self-Efficacy	157
Health and Therapeutic	
Activities	159

Instructional Applications	160
Models and Self-Efficacy	160
Worked Examples	161
Tutoring and Mentoring	162

Summary and Critique 163

Reflection Questions 166

Further Reading 167

5 Information Processing Theory: Encoding and Storage 168

Early Information Processing Perspectives	170
Assumptions	170
Verbal Learning	170
Gestalt Theory	173
Two-Store (Dual) Memory	
Model	176
Levels (Depth) of Processing	178

Contemporary Information Processing Model 180

Attention	182
Theories of Attention	182
Attention and Learning	183
Meaning and Importance	184

Perception	186
Sensory Registers	186
LTM Comparisons	187

Encoding 188

- Working Memory (WM) 188
- Influences on Encoding 191

Long-Term Memory: Storage 195

- Propositions 195
- Storage of Knowledge 197
- Production Systems and Connectionist Models 201

Instructional Applications 205

- Advance Organizers 205
- Conditions of Learning 207
- Cognitive Load 210

Summary and Critique 212**Reflection Questions 214****Further Reading 215****6 Information Processing Theory: Retrieval and Forgetting 216****Long-Term Memory: Retrieval 218**

- Retrieval Processes 218
- Language Comprehension 223

Forgetting 227

- Interference Theory 227
- Information Processing 230

Relearning 232

- Memory Savings 232
- Effect of Testing 233

Visual Memory 233

- Representation of Visual Information 234
- Visual Memory and LTM 236
- Individual Differences 237

Transfer 237

- Historical Views 238
- Contemporary Perspectives 239
- Types of Transfer 240
- Strategy Transfer 243

Instructional Applications 244

- Encoding-Retrieval Similarity 244

- Retrieval-Based Learning 245
- Teaching for Transfer 246

Summary and Critique 247**Reflection Questions 250****Further Reading 251****7 Cognitive Learning Processes 252****Skill Acquisition 254**

- General and Specific Skills 254
- Novice-to-Expert Research Methodology 255
- Expert–Novice Differences in Science 257

Metacognition 258

- Conditional Knowledge 259
- Metacognition and Learning 260
- Variables Influencing Metacognition 261
- Metacognition and Epistemic Thinking 263
- Metacognition and Behavior 264
- Metacognition and Reading 265

Concept Learning 267

- The Nature of Concepts 267
- Concept Attainment 269
- Teaching of Concepts 270
- Motivational Processes 273

Problem Solving 274

- Historical Perspectives 275
- Heuristics 277
- Problem-Solving Strategies 278
- Problem Solving and Learning 283
- Experts and Novices 284

Critical Thinking, Reasoning, and Creativity 285

- Critical Thinking 285
- Reasoning 287
- Creativity 291

Cognition and Technology 292

- Computer-Based Learning Environments 293
- Online Social Media 299
- Distance Learning 300

Instructional Applications 302

- Worked Examples 302
- Problem Solving 303
- Mathematics 305

Summary and Critique 309**Reflection Questions 311****Further Reading 311****8 Constructivism 312****Assumptions and Perspectives 314**

- Overview 315
- Perspectives 316
- Situated Cognition 317

Piaget's Theory of Cognitive Development 319

- Developmental Processes 320
- Implications for Instruction 323

Neo-Piagetian Theories 324

- Assumptions 324
- Case's Instructional Model 325

Bruner's Theory of Cognitive Growth 327

- Knowledge Representation 327
- Spiral Curriculum 328

Vygotsky's Sociocultural Theory 330

- Background 330
- Basic Principles 331
- Zone of Proximal Development 332
- Applications 334

Private Speech and Socially Mediated Learning 338

- Private Speech 338
- Verbalization and Achievement 339

- Socially Mediated Learning 341
- Peer-Assisted Learning 343

Constructivist Learning**Environments 344**

- Key Features 345
- APA Learner-Centered Principles 347
- Reflective Teaching 347

Instructional Applications 351

- Discovery Learning 351
- Inquiry Teaching 354
- Discussions and Debates 355

Summary and Critique 355**Reflection Questions 358****Further Reading 359****9 Motivation 360****Background and Assumptions 362**

- Historical Perspectives 362
- Humanistic Theories 366
- Model of Motivated Learning 371

Achievement Motivation 373

- Expectancy-Value Theory 373
- Contemporary Model of Achievement Motivation 375
- Family Influences 378
- Self-Worth Theory 379
- Task and Ego Involvement 380

Attributions 381

- Locus of Control 381
- Naïve Analysis of Action 382
- Attribution Theory of Achievement 383

Social Cognitive Processes 386

- Goals and Expectations 386
- Social Comparison 387
- Self-Concept 389

Goal Orientations 392

- Types of Goal Orientations 392
- Conceptions of Ability 396
- Implicit Theories 396

Intrinsic Motivation 398
 Early Views 398
 Perceived Control 400
 Self-Determination 402
 Rewards and Intrinsic Motivation 403

Interest and Affect 406
 Personal and Situational Interest 406
 Emotions 407

Instructional Applications 408
 Achievement Motivation Training 408
 Attribution Change Programs 409
 Goal Orientations 411

Summary and Critique 413

Reflection Questions 415

Further Reading 415

10 Self-Regulated Learning 416

Assumptions 418

Behavioral Self-Regulation 419
 Self-Monitoring 419
 Self-Instruction 422
 Self-Reinforcement 423

Social Cognitive Influences 423
 Conceptual Framework 423
 Self-Regulatory Processes 425
 Cyclical Nature of Self-Regulated Learning 428
 Social-Self Interaction 432

Information Processing 432
 Model of Self-Regulated Learning 433
 Learning Strategies 434

Constructivism 444
 Sociocultural Influences 444
 Implicit Theories 446

Motivation and Self-Regulated Learning 448
 Volition 449
 Values 450

Self-Schemas 451
 Help Seeking 451

Instructional Applications 452
 Academic Studying 452
 Writing 454
 Technology 457

Summary and Critique 458

Reflection Questions 460

Further Reading 461

11 Contextual Influences 462

Teachers, Classrooms, and Schools 465
 Effective Learning
 Environments 465
 Teacher–Student Interactions 469
 Developmentally Appropriate Instruction 473
 Transitions in Schooling 474
 Classroom and School Climate 476

Peers 478
 Peers and Learning 478
 Peer Networks 480
 Peers and School Adjustment 481

Families 483
 Socioeconomic Status 483
 Home Environment 486
 Parental Involvement 486
 Electronic Media 489

Communities 492
 Location 492
 Community Involvement 493

Cultures 494

Instructional Applications 496
 Teacher–Student Interactions 496
 Learning Styles 499
 Parental and Familial Involvement 503

Summary and Critique 504

Reflection Questions 506

Further Reading 507

12 Next Steps 508

Learning Questions 509

How Does Learning Occur? 509

How Does Memory Function? 509

What Is the Role of Motivation? 509

How Does Transfer Occur? 510

How Does Self-Regulated Learning
Operate? 510

What Are the Implications for
Instruction? 510

Learning Theories 510

Conditioning 511

Social Cognitive 511

Information Processing 511

Constructivist 511

Future Developments 511

Conclusion 512

Glossary 514

References 527

Author Index 569

Subject Index 582

This page intentionally left blank

1 Introduction to the Study of Learning

Russ Nyland teaches a graduate education course on learning and cognition. Toward the end of the semester, three students approach him: Jeri Kendall, Matt Bowers, and Trisha Pascella.

Jeri: Dr. Nyland, can we talk with you? It's late in the course, and we're still confused.

Russ: About what?

Jeri: Well, we've been studying all these theorists. It seems like they're saying different things, but maybe not. Skinner, Bandura, Vygotsky, and the others. They make different points, but then some of what they say seems to overlap what others say.

Matt: I'm confused too. I read these theorists and agree with what they're saying. But am I supposed to have only one theory, to believe one way and not others? There's a lot of overlap between theories.

Russ: You're right, Jeri and Matt; there is overlap. Most of what we've studied in this course involves cognition. Cognitive theories are alike because they say that learning involves changes in cognitions—knowledge, skills, beliefs. Most theorists also say that learners construct their knowledge and beliefs; they don't automatically adopt what somebody tells them.

Trisha: So then what should we do? Am I supposed to be something like an information processing theorist, a social cognitive theorist, a constructivist? That's what I'm confused about.

Russ: No, you don't have to be only one. There may be one theory that you like better than the others, but maybe that theory doesn't address everything you want it to. So then you can borrow from other theories. For example, when I was in grad school, I did research with a professor whose specialty was cognitive learning. There was another professor who did developmental research. I really liked her research, probably because I had been a teacher and was interested in development, especially the changes in students from elementary to middle school. So I was a learning theorist who borrowed from the developmental literature. I still do. It's okay to do that!

- Jeri: Well, that makes me feel better. But it's late in the course, and I want to know what I should be doing next.
- Russ: Tell you what—next class I'll spend some time on this. A good place to start is not to decide which type of theorist you are but rather determine what you believe about learning and what types of learning you're interested in. Then you can see which theory matches up well to your beliefs and assumptions and maybe do as I did—borrow from others.
- Matt: Isn't that being eclectic?
- Russ: Perhaps, but you may still have one preferred theory that you adapt as needed. It's okay to do that. In fact, that's how theories are improved—by revising and incorporating ideas that weren't in them originally.
- Trisha: Thanks Dr. Nyland. This is really helpful.

Learning involves acquiring and modifying knowledge, skills, strategies, beliefs, attitudes, and behaviors. People learn cognitive, behavioral, linguistic, motor, and social skills, and these can take many forms. At a simple level, children learn to solve $2 + 2 = ?$, to recognize *y* in the word *daddy*, to tie their shoes, and to play with other children. At a more complex level, students learn to solve long-division problems, write term papers, ride a bicycle, and work cooperatively on group projects.

This book focuses on how human learning occurs, which factors influence it, and how learning principles apply in educational contexts. Animal learning is de-emphasized, which is not intended to downgrade its importance because we have gained much knowledge about learning from animal research. But human learning is fundamentally different from animal learning because human learning typically involves language and is more complex, elaborate, and rapid.

This chapter provides an overview of the study of learning. Initially, learning is defined and examined in settings where it occurs. An overview is given of some important philosophical and psychological precursors of contemporary theories that helped to establish the groundwork for the application of learning theories to education. The roles of learning theory

and research are discussed, and methods commonly used to assess learning are described. The links between learning theories and instruction are explained, after which some critical issues in the study of learning are presented.

The opening scenario describes a situation that many students find themselves in when they take a course in learning, instruction, or motivation and are exposed to different theories. Students often think that they are supposed to believe in one theory and adopt the views of those theorists. They may be confused by the perceived overlap between theories.

As Russ Nyland says, that is normal. Although theories differ in many ways, including their general assumptions and guiding principles, many rest on a common foundation of cognition. This text focuses on these cognitive theories of learning, which contend that learning involves changes in learners' constructions: their thoughts, beliefs, knowledge, strategies, and skills. These theories differ in how they predict that learning occurs, which learning processes are important, and which aspects of learning they stress. Some theories are oriented more toward basic learning and others toward applied learning (and, within that, in different content areas); some stress the role of development, others are strongly linked with instruction; and some emphasize motivation (Bruner, 1985).

Russ advises students to examine their beliefs and assumptions about learning rather than decide which type of theorist they are. This is good advice. Theories are perspectives on learning. They are neither right nor wrong. Rather, they help us understand learning and act accordingly. Once we are clear about where we stand on learning in general, then the theoretical perspective or perspectives that are most relevant will emerge. As you study this text, it will help if you reflect on your beliefs and assumptions about learning and decide how these align with the theories.

This introductory chapter is important because it should prepare you for an in-depth study of learning by providing a framework for understanding learning and some background material against which to view contemporary theories. It also covers types of research to investigate learning and ways to assess it. These are topics that everyone interested in learning should be familiar with.

When you finish studying this chapter, you should be able to do the following:

- Define learning and identify instances of learned and unlearned phenomena.
- Distinguish between rationalism and empiricism, explain the major tenets of each, and discuss how rationalism and empiricism are reflected in contemporary learning theories and research.
- Discuss how the work of Wundt, Ebbinghaus, the Structuralists, and the Functionals helped to establish psychology as a science.
- Describe the major features of different research paradigms.
- Discuss the central features of different methods of assessing learning, including educational data mining and criteria for assessment methods.
- Explain what value-added assessment of learning is and how it can be used to determine progress in student learning.
- Explicate the ways that learning theory and educational practice complement and refine one another.
- Explain differences between behavior and cognitive theories with respect to various issues in the study of learning.

LEARNING DEFINED

Although people agree that learning is important, they hold different views on the causes, processes, and consequences of learning (Alexander, Schallert, & Reynolds, 2009; Geary, 2009). There is no one definition of learning that is universally accepted by theorists, researchers, and practitioners. Despite disagreement about the precise nature of learning, the following is a general definition of learning that is consistent with this book's cognitive focus and that captures the criteria most educational professionals consider central to learning.

Learning is an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience.

Let us examine this definition in depth to identify three criteria of learning (Table 1.1).

One criterion is that *learning involves change*—in behavior or in the capacity for behavior. Change is a central ingredient of learning (Alexander et al., 2009). When people learn, they become capable of doing something differently. A key point is that we do not

Table 1.1
Criteria of learning.

-
- Learning involves change
 - Learning endures over time
 - Learning occurs through experience
-

observe learning directly but rather its products or outcomes. In other words, *learning is inferential*—it is demonstrated based on what people say, write, and do. The definition also says that learning involves a changed capacity to behave in a given fashion because people can learn skills, knowledge, beliefs, and behaviors without demonstrating them at the time they learn them (Chapter 4).

A second criterion is that *learning endures over time*. This criterion excludes temporary behavioral changes (e.g., slurred speech) brought about by such factors as drugs, alcohol, and fatigue. Such changes are temporary because when the cause is removed, the behavior returns to its original state. Although learning is enduring, it may not last forever because forgetting occurs. Researchers debate how long changes must last to be classified as learned, but most people agree that changes of brief duration (e.g., a few seconds) do not qualify as learning.

A third criterion is that *learning occurs through experience* (e.g., practice, thinking, observation of others). This criterion excludes behavioral changes that are primarily determined by heredity, such as maturational changes in children (e.g., crawling, standing). Nonetheless, the distinction between maturation and learning often is not clear-cut. People may be genetically predisposed to act in given ways, but the actual development of the particular behaviors depends on the environment. Language offers a good example. As the human vocal apparatus matures, it becomes able to produce language such that children acquire language in much the same type of trajectory (Goldin-Meadow et al., 2014). The actual words produced, however, are learned from interactions with others. Although genetics are critical for children's language acquisition, teaching and social interactions with parents, teachers, and peers exert a strong influence on children's language achievements (Mashburn, Justice, Downer, & Pianta, 2009). In similar fashion, with normal development, children crawl and stand, but the environment must be responsive and allow these behaviors to occur. Children whose language and movements cannot be expressed freely in an environment may not develop normally.

PRECURSORS OF MODERN LEARNING THEORIES

The roots of contemporary theories of learning extend far into the past. Many issues addressed and questions asked by researchers today are not new but rather reflect the continuing desire for people to understand themselves, others, and the world about them.

It is important to understand the origins of contemporary learning theories, which this section traces beginning with philosophical positions on the origin of knowledge and its relation to the environment and concluding with some early psychological views on learning. This review is selective and includes historical material relevant to learning in educational settings. Readers interested in a more comprehensive discussion should consult historical sources (Bower & Hilgard, 1981; Heidbreder, 1933; Hunt, 1993).

Learning Theory and Philosophy

From a philosophical perspective, learning can be discussed under the heading of *epistemology*, which refers to the study of the origin, nature, limits, and methods of knowledge. How do we know? How do we learn something new? What is the source of knowledge? The complexity of how humans learn is illustrated in Plato's *Meno* (427?–347? B.C.):

I know, Meno, what you mean . . . You argue that a man cannot enquire (*sic*) either about that which he knows, or about that which he does not know; for if he knows, he has no need to enquire (*sic*); and if not, he cannot; for he does not know the very subject about which he is to enquire (*sic*). (Plato, 1965, p. 16)

Two positions on the origin of knowledge and its relationship to the environment are rationalism and empiricism. These philosophies are recognizable in current learning theories.

Rationalism. *Rationalism* reflects the idea that knowledge derives from reason without recourse to the senses. The distinction between mind and matter, which figures prominently in rationalist views of human knowledge, can be traced to Plato, who distinguished knowledge acquired via the senses from that gained by reason. Plato believed that things (e.g., houses, trees) are revealed to people via the senses, whereas individuals acquire knowledge of ideas by reasoning or thinking about what they know. People have ideas about the world, and they learn (discover) these ideas by reflecting upon them. Reason is the highest mental faculty because through reason, people discover abstract ideas. The true nature of houses and trees can be known only by reflecting upon the ideas of houses and trees.

Plato escaped the dilemma expressed in *Meno* by assuming that true knowledge, or the knowledge of ideas, is innate and is brought into awareness through reflection. Learning is recalling what exists in the mind. Information acquired via the senses by seeing, hearing, tasting, smelling, or touching constitutes raw materials rather than ideas. The mind is innately structured to reason and provide meaning to incoming sensory information.

The rationalist doctrine also is evident in the writings of René Descartes (1596–1650), a French philosopher and mathematician. Descartes employed doubt as a method of inquiry. By doubting, he arrived at conclusions that were absolute truths and not subject to doubt. The fact that he could doubt led him to believe that the mind (thought) exists, as reflected in his dictum, “I think, therefore I am.” Through deductive reasoning from general premises to specific instances, he showed that God existed and concluded that ideas arrived at through reason must be true.

Like Plato, Descartes established a mind–matter dualism; however, for Descartes, the external world was mechanical, as were the actions of animals. People are distinguished by their ability to reason. The human soul, or the capacity for thought, influences the body's mechanical actions, but the body acts on the mind by bringing in sensory experiences. Although Descartes postulated dualism, he also hypothesized mind–matter interaction.

The rationalist perspective was extended by the German philosopher Immanuel Kant (1724–1804). In his *Critique of Pure Reason* (1781), Kant addressed mind–matter dualism and noted that the external world is disordered but is perceived as orderly because order is imposed by the mind. The mind takes in the external world through the senses and

alters it according to subjective, innate laws. The world never can be known as it exists but only as it is perceived. People's perceptions give the world its order. Kant reaffirmed the role of reason as a source of knowledge but contended that reason operates within the realm of experience. Absolute knowledge untouched by the external world does not exist. Rather, knowledge is empirical in the sense that information is taken in from the world and interpreted by the mind.

In summary, rationalism is the doctrine that knowledge arises through the mind. Although there is an external world from which people acquire sensory information, ideas originate from the workings of the mind. Descartes and Kant believed that reason acts upon information acquired from the world; Plato thought that knowledge can be absolute and acquired by pure reason.

Empiricism. In contrast to rationalism, *empiricism* reflects the idea that experience is the only source of knowledge. This position derives from Aristotle (384–322 B.C.), who was Plato's student and successor. Aristotle drew no sharp distinction between mind and matter. The external world is the basis for human sense impressions, which, in turn, are interpreted as lawful (consistent, unchanging) by the mind. The laws of nature cannot be discovered through sensory impressions but rather through reason as the mind takes in data from the environment. Unlike Plato, Aristotle believed that ideas do not exist independently of the external world, which is the source of all knowledge.

Aristotle's contribution to psychology was his principles of association as applied to memory. The recall of an object or idea triggers recall of other objects or ideas similar to, different from, or experienced close in time or space, to the original object or idea. The more that two objects or ideas are associated, the more likely that recall of one will trigger recall of the other. Such associative learning is reflected in many learning theories (Shanks, 2010).

Another influential figure was British philosopher John Locke (1632–1704), who developed an empirical school of thought that stopped short of being truly experimental. In his *Essay Concerning Human Understanding* (1690), Locke noted that there are no innate ideas; all knowledge derives from two types of experience: sensory impressions of the external world and personal awareness. At birth, the mind is a *tabula rasa* (blank tablet). Ideas are acquired from sensory impressions and personal reflections on these impressions. What is in the mind originated in the senses. The mind is composed of ideas that have been combined in different ways. The mind can be understood only by breaking down ideas into simple units. This atomistic view of thought is associationist; complex ideas are collections of simple ones.

The issues Locke raised were debated by such profound thinkers as George Berkeley (1685–1753), David Hume (1711–1776), and John Stuart Mill (1806–1873). Berkeley believed that mind is the only reality. He was an empiricist because he believed that ideas derive from experiences. Hume agreed that people never can be certain about external reality, but he also believed that people cannot be certain about their own ideas. Individuals experience external reality through their ideas, which constitute the only reality. At the same time, Hume accepted the empiricist doctrine that ideas derive from experience and become associated with one another. Mill was an empiricist and associationist, but he rejected the idea that simple ideas combine in orderly ways to form complex ones.

Mill argued that simple ideas generate complex ideas, although the latter need not be composed of the former. Simple ideas can produce a complex thought that might bear little relation to the ideas of which it is composed. Mill's beliefs reflect the notion that the whole is greater than the sum of its parts, which is an integral assumption of Gestalt psychology (Chapter 5).

In summary, empiricism holds that experience is the only form of knowledge. Beginning with Aristotle, empiricists have contended that the external world serves as the basis for people's impressions. Most accept the notion that objects or ideas associate to form complex stimuli or mental patterns. Locke, Berkeley, Hume, and Mill are among the better-known philosophers who espoused empiricist views.

Knowing about philosophical positions that underlie learning theories helps us better understand the latter. Philosophical positions suggest the types of research conducted by researchers adopting different theoretical positions. Thus, theories that reflect a rationalist perspective are apt to be concerned with learners' perceptions of learning environments and ways that learners construct knowledge. These research methods might try to tap qualitative measures such as learners' reflections at various points during learning. In contrast, theories that reflect empiricism may place greater emphasis on environmental variables and the effects these might have on the associations made by learners. These theories may also examine how complex types of learning are built up from more basic ones. The research methods are likely to include measures and variables that can be quantified.

It should be emphasized that philosophical positions and learning theories do not neatly map onto one another; however, behavior theories (Chapter 3) typically are empiricist in their orientation whereas cognitive theories (Chapters 4–8) are more rationalistic. But overlap and exceptions occur. For example, most theories posit that some learning occurs through association. Cognitive theories stress association between cognitions and emotions; behavior theories emphasize the association of stimuli with responses and consequences. And more recent behavior theories have begun to include cognition (Chapter 3). Information processing (Chapters 5 and 6) seems highly empiricist at times, but it does emphasize the construction of knowledge. So we are left with complexity such that it is best not to overgeneralize how a particular philosophical position may manifest itself in a given learning theory.

Beginnings of the Psychological Study of Learning

Although the study of learning is probably “as old as the sun,” the formal beginning of the psychological study of learning is more recent but difficult to pinpoint. Systematic psychological research began to appear in the latter part of the 19th century. Two persons who had a significant impact on learning theory are Wundt and Ebbinghaus.

Wundt's Psychological Laboratory. The first psychological laboratory was opened by Wilhelm Wundt (1832–1920) in Leipzig, Germany, in 1879, although William James had started a teaching laboratory at Harvard University four years earlier (Dewsbury, 2000). Wundt wanted to establish psychology as a new science. His laboratory acquired an international reputation with an impressive group of visitors, and he founded a journal to report psychological research. The first research laboratory in the United States was opened in 1883 by G. Stanley Hall (Dewsbury, 2000).

Establishing a psychological laboratory was particularly significant because it marked the transition from philosophical theorizing to an emphasis on experimentation and instrumentation (Evans, 2000). The laboratory included scholars who conducted research aimed at scientifically explaining phenomena (Benjamin, 2000). In his 1873 book *Principles of Physiological Psychology*, Wundt contended that psychology is the study of the mind. The psychological method should be patterned after the physiological method; that is, the process being studied should be experimentally investigated in terms of controlled stimuli and measured responses.

Wundt's researchers investigated such phenomena as sensation, perception, reaction times, verbal associations, attention, feelings, and emotions. Wundt also was a mentor for many psychologists who subsequently opened laboratories in the United States (Benjamin, Durkin, Link, Vestal, & Acord, 1992). Although Wundt's laboratory produced no great psychological discoveries or critical experiments, it established psychology as a discipline and experimentation as the method of acquiring and refining knowledge.

Ebbinghaus's Verbal Learning. Hermann Ebbinghaus (1850–1909) was a German psychologist who helped to validate the experimental method and establish psychology as a science. Ebbinghaus investigated higher mental processes by conducting research on memory (Erdelyi, 2010). He accepted the principles of association and believed that learning and the recall of learned information depend on the frequency of exposure to the material. Properly testing this hypothesis required using material with which participants were unfamiliar. Ebbinghaus invented *nonsense syllables*, which are three-letter consonant-vowel-consonant combinations (e.g., cew, tij).

Ebbinghaus often used himself as the subject of study (Erdelyi, 2010). In a typical experiment, he would devise a list of nonsense syllables, look at each syllable briefly, pause, and then look at the next syllable. He determined how many times through the list (trials) it took to him learn the entire list. He made fewer errors with repeated study of the list, needed more trials to learn more syllables, forgot rapidly at first but then more gradually, and required fewer trials to relearn syllables than to learn them the first time. He also studied a list of syllables some time after original learning and calculated a *savings score*, defined as the time or trials necessary for relearning as a percentage of the time or trials required for original learning. He found that meaningfulness of material made learning easier. The results of his research are compiled in the 1885/1964 book *Memory*.

Although important historically, there are concerns about this research. Ebbinghaus typically employed only one participant (himself), and it is unlikely he was unbiased or a typical learner. We also might question how well results for learning nonsense syllables generalize to meaningful learning (e.g., text passages). Nonetheless, Ebbinghaus was a careful researcher, and many of his findings later were validated experimentally. He was a pioneer in bringing higher mental processes into the experimental laboratory.

Structuralism and Functionalism

The work by Wundt and Ebbinghaus was systematic but confined to particular locations and of limited influence on psychological theory. The turn of the century marked the

beginning of more widespread schools of psychological thought. Two perspectives that emerged were structuralism and functionalism. Although neither exists as a unified doctrine today, their early proponents were influential in the history of psychology as it relates to learning.

Structuralism. Edward B. Titchener (1867–1927) was Wundt’s student in Leipzig. Titchener became the director of the psychology laboratory at Cornell University in 1892 and imported Wundt’s experimental methods into U.S. psychology.

Titchener’s psychology, which eventually became known as *structuralism*, reflected empiricism because it represented a combination of associationism with the experimental method. Structuralists believed that human consciousness is a legitimate area of scientific investigation, and they studied the structure or makeup of mental processes. They postulated that the mind is composed of associations of ideas that to be studied must be broken down into single ideas (Titchener, 1909).

The experimental method used often by Wundt, Titchener, and other structuralists was *introspection*, a type of self-analysis. Participants in introspection studies verbally reported their immediate experiences following exposure to objects or events. For example, if shown a table, they might report their perceptions of shape, size, color, and texture. They were told not to label or report their knowledge about the object or the meanings of their perceptions. Thus, if they verbalized “table” while viewing a table, they were attending to the stimulus rather than to their conscious processes.

Introspection was a uniquely psychological process and helped to demarcate psychology from the other sciences. It was a professional method that required training in its use so that an introspectionist could determine when individuals were examining their own conscious processes rather than their interpretations of phenomena.

Unfortunately, introspection often was problematic and unreliable. It is difficult and unrealistic to expect people to ignore meanings and labels. When shown a table, it is natural that people say “table,” think of uses, and draw on related knowledge. The mind is not structured to compartmentalize information so neatly, so by ignoring meanings introspectionists disregarded a central aspect of the mind. Watson (Chapter 3) decried the use of introspection, and its problems helped to rally support for an objective psychology that studied only observable behavior (Heidbreder, 1933). Edward L. Thorndike, a prominent psychologist (Chapter 3), contended that education should be based on scientific facts, not opinions (Popkewitz, 1998). The ensuing emphasis on behavioral psychology dominated U.S. psychology for the first half of the 20th century.

Another problem was that structuralists studied associations of ideas, but they had little to say about how these associations are acquired. Further, it was not clear that introspection was the appropriate method to study such higher mental processes as reasoning and problem solving, which are more complex than immediate sensation and perception.

Functionalism. While Titchener was at Cornell, other developments challenged the validity of structuralism. Among these was *functionalism*, the view that mental processes and behaviors of living organisms help them adapt to their environments (Heidbreder, 1933). This school of thought flourished at the University of Chicago with John Dewey (1867–1949)

and James Angell (1869–1949). Another prominent functionalist was William James (1842–1910). Functionalism was the dominant American psychological perspective from the 1890s until World War I (Green, 2009).

James's principal work was the two-volume series, *The Principles of Psychology* (1890), which is considered one of the greatest psychology texts (Hall, 2003). An abridged version was published for classroom use (James, 1892). James was an empiricist who believed that experience is the starting point for examining thought, but he was not an associationist. He thought that simple ideas are not passive copies of environmental inputs but rather are the product of abstract thought and study (Pajares, 2003).

James (1890) postulated that consciousness is a continuous process rather than a collection of discrete bits of information. One's "stream of thought" changes as experiences change. James described the purpose of consciousness as helping individuals adapt to their environments.

Functionalists incorporated James's ideas into their doctrine. Dewey (1896) believed that psychological processes could not be broken into discrete parts and that consciousness must be viewed holistically. "Stimulus" and "response" describe the roles played by objects or events, but these roles could not be separated from the overall reality (Bredo, 2003). Dewey cited an example from James (1890) about a baby who sees a candle burning, reaches out to grasp it, and experiences burned fingers. From a stimulus–response perspective, the sight of the candle is a stimulus, and reaching is a response; getting burned (pain) is a stimulus for the response of withdrawing the hand. Dewey argued that this sequence is better viewed as one large coordinated act in which seeing and reaching influence each other.

Functionalists were influenced by Darwin's writings on evolution and studied how mental processes helped organisms adapt to their environments and survive (Bredo, 2003; Green, 2009). Functionalists were interested in how mental processes (e.g., thinking, feeling, judging) operate, what they accomplish, and how they vary with environmental conditions. They also saw the mind and body as interacting rather than existing separately.

Functionalists opposed the introspection method, not because it studied consciousness but rather because of how it studied consciousness. Introspection attempted to reduce consciousness to discrete elements, which functionalists believed was not possible. Studying a phenomenon in isolation does not reveal how it contributes to an organism's survival.

Dewey (1900) argued that the results of psychological experiments should be applicable to education and daily life. Although this goal was laudable, it also was problematic because the research agenda of functionalism was too broad to offer a clear focus. Structuralists and functionalists believed in the value of research, but they approached it differently. Structuralism reflected the tenets of empiricism, whereas functionalism was better aligned with rationalism. But both perspectives had weaknesses involving research. These weaknesses paved the way for the rise of behaviorism as the dominant force in U.S. psychology (Chapter 3). Behaviorism reflected empiricism because it emphasized experimentation and observable phenomena, which helped to secure psychology's standing as a science (Asher, 2003; Tweney & Budzynski, 2000).

LEARNING THEORY AND RESEARCH

Theory and research are integral to the study of learning. This section discusses some general functions of theory, along with key aspects of the research process. Readers who are knowledgeable about these topics may wish to omit this section.

Functions of Theory

A *theory* is a scientifically acceptable set of principles offered to explain a phenomenon. Theories are perspectives on learning that provide frameworks for interpreting environmental observations. They also help to bridge the gap between research and education. Research findings can be organized and systematically linked to theories. Theories provide a scientific basis for education regarding how people think, feel, and act (Sternberg, 2008). Without theories, people might view research findings as disorganized collections of data, because researchers and practitioners would have no overarching frameworks to which the data could be linked. Even when researchers obtain findings that do not seem to be directly linked to theories, they still must attempt to make sense of data and determine whether the data support theoretical predictions.

Theories reflect environmental phenomena and generate new research through *hypotheses*, or assumptions that can be empirically tested. Hypotheses can be cast as statements of relation, such as, “*X* should relate positively to *Y*,” or as if-then statements (e.g., “If I do *X*, then *Y* should occur,”) where *X* and *Y* might be such events as “give students feedback on their progress in learning” and “promote their learning,” respectively. Thus, we might test the hypothesis, “If we give students feedback on their progress in learning, then they should display better learning.” A theory is strengthened when hypotheses are supported by data. Theories may require revision if data do not support hypotheses.

When researchers explore areas where there is little theory to guide them, they formulate research objectives or questions to be answered (e.g., “How will students’ learning be affected when they receive feedback on their learning progress?”). Regardless of whether researchers are testing hypotheses or exploring questions, they need to specify the research conditions as precisely as possible.

Because research forms the basis for theory development and has important implications for teaching, the next section examines types of research and the process of conducting research. Readers familiar with this material may wish to omit this section.

Conducting Research

To specify the research conditions, researchers need to answer such questions as: Who will participate? Where will the research study be conducted? What procedures will be employed? What are the variables and outcomes to be assessed?

Researchers must define precisely the phenomena they are studying by providing conceptual and operational definitions. An *operational definition* defines a phenomenon in terms of the measures and procedures used to assess it. For example, a researcher might define *self-efficacy* (covered in Chapter 4) conceptually as one’s perceived capabilities for

learning or performing a task and operationally by specifying the measures and procedure used to assess self-efficacy in the research study (e.g., one's score on a 30-item questionnaire administered privately before students received instruction). Ideally, conditions are specified so precisely that, after reading the description, another researcher could replicate the study.

Research studies that explore learning employ various types of *paradigms* (or *models*; Table 1.2). The following paragraphs describe the correlational, experimental, and qualitative paradigms, followed by a discussion of laboratory and field studies.

Correlational Research. *Correlational research* deals with exploring relations that exist between variables. A researcher might hypothesize that self-efficacy is positively correlated with (related to) achievement such that the higher the students' self-efficacy, the higher they achieve. To test this relation, the researcher might measure students' self-efficacy for solving mathematical problems and then assess how well they solve the problems. The researcher could statistically correlate the self-efficacy and achievement scores to determine the direction of the relation (positive, negative) and its strength (high, medium, low).

Correlational research helps to clarify relations among variables. Correlational findings often suggest directions for further research. If the researcher were to obtain a high positive correlation between self-efficacy and achievement, the next study might be an experiment that attempts to raise students' self-efficacy for learning and determine whether such an increase produces higher achievement.

A limitation of correlational research is that it cannot identify cause and effect. A positive correlation between self-efficacy and achievement could mean that (a) self-efficacy influences achievement, (b) achievement influences self-efficacy, (c) self-efficacy and achievement influence each other, or (d) both self-efficacy and achievement are influenced by other, nonmeasured variables (e.g., parents, teachers). To determine cause and effect, experimental studies are necessary.

Experimental Research. In *experimental research*, the researcher changes one or more (independent) variables and determines the effects on other (dependent) variables. A researcher could form two groups of students, systematically raise self-efficacy beliefs among students in one group and not among students in the other group, and assess achievement in the two groups. If the first group performs better, the researcher might

Table 1.2
Learning research paradigms.

Type	Qualities
Correlational	Examines relations between variables
Experimental	One or more variables are altered and effects on other variables are assessed
Qualitative	Concerned with description of events and interpretation of meanings
Laboratory	Project conducted in a controlled setting
Field	Project conducted in a natural setting (e.g., school, home, work)

conclude that self-efficacy influences achievement. While the researcher alters variables and assesses their effects on outcomes, she or he must hold constant other variables that potentially can affect outcomes (e.g., learning conditions).

Experimental research, which often is conducted by researchers in the empiricism tradition, can clarify cause–effect relations, which helps us understand the nature of learning. At the same time, experimental research often is narrow in scope. Such research typically involved quantitative data, which includes closed-ended information on beliefs and performance instruments (Creswell & Plano-Clark, 2007). Researchers typically study only a few variables and try to minimize effects of others, which is difficult to do and often unrealistic. Classrooms and other learning settings are complex places where many variables operate at once. To say that one or two variables cause outcomes may overemphasize their importance. It is necessary to replicate experiments and examine other variables to better understand effects.

Qualitative Research. The *qualitative research* paradigm is characterized by intensive study, descriptions of events, and interpretation of meanings. The theories and methods used are referred to with various labels including qualitative, ethnographic, participant observation, phenomenological, constructivist, and interpretative (Erickson, 1986). It is often conducted by researchers in the rationalist tradition.

Qualitative research is especially useful when researchers are interested in the structure of events rather than their overall distributions, when the meanings and perspectives of individuals are important, when actual experiments are impractical or unethical, and when there is a desire to search for new potential causal linkages that have not been discovered by experimental methods (Erickson, 1986). Qualitative research is varied and can range from analyses of verbal and nonverbal interactions within single lessons to in-depth observations and interviews over longer periods. Methods may include observations, use of existing records, interviews, and think-aloud protocols (i.e., participants talk aloud while performing tasks). It is not the choice of method that characterizes this approach—all of the aforementioned methods could be used in correlational or experimental studies—but rather the depth and quality of data analysis and interpretation.

A qualitative researcher might be curious about how self-efficacy contributes to the development of skills over time. She or he might work with a small group of students for several weeks. Through observations, interviews, and other forms of data collection, the researcher might examine how students' self-efficacy for learning changes in relation to their learning in reading, writing, and mathematics.

Quantitative and qualitative methods can be used together in a research study, which is known as *mixed-methods research* (Creswell & Plano-Clark, 2007). Qualitative research yields rich sources of open-ended data, which are more intensive and thorough than those typically obtained with quantitative methods. This model also can raise new questions and fresh perspectives on old questions that often are missed by traditional methods. A potential limitation is that qualitative studies typically include only a few participants, who may not be representative of a larger population of students or teachers. This limits generalization of findings beyond the research context. Another limitation is that data collection, analysis, and interpretation can be time-consuming and therefore impractical for students wanting to graduate and professors wanting to build their publication records! But

as a research model, this paradigm offers a useful approach for obtaining data typically not collected with other methods.

Laboratory and Field Research. *Laboratory research* is conducted in controlled settings, whereas *field research* is conducted where participants live, work, or attend school. During the first half of the 20th century, most learning research was conducted on animals in laboratories. Today most learning research is conducted with people, and much is done in field settings. Any of the preceding research models (experimental, correlational, qualitative) can be applied in the laboratory or the field.

Laboratories offer a high degree of control over extraneous factors that can affect results, such as equipment noises (e.g., ringing phones), people talking, windows to look out of, and other persons in the room who are not part of the study. Light, sound, and temperature can be regulated. Laboratories also allow researchers to leave their equipment set up over lengthy periods and have all materials at their immediate disposal.

Such control is not possible in the field. Schools are noisy, and often it is difficult to find space to work. There are numerous distractions: Students and teachers walk by, bells ring, public announcements are made, and fire drills are held. Rooms may be too bright or dark, cold or warm, and they may be used for other purposes so researchers have to set up equipment each time they work. Interpreting results in light of these distractions can be a problem.

An advantage of field research is that results are highly generalizable to other similar settings because studies are conducted where people typically learn. In contrast, generalization of laboratory findings to the field is done with less confidence. Laboratory research has yielded many important insights on learning, and researchers often attempt to replicate laboratory findings in the field.

Whether the laboratory or the field is employed depends on such factors as the purpose of the research, availability of participants, costs, and how the results will be used. The laboratory adds control but loses some generalizability, and vice versa with the field. In the field, researchers try to minimize extraneous influences so that they can be more confident that their results are due to the variables they are studying.

ASSESSMENT OF LEARNING

Because learning is inferential, we do not directly observe it but rather its products—what learners say and do. Researchers and practitioners who work with students may believe that students have learned, but to be more certain, they must assess learning's outcomes. *Assessment* involves “a formal attempt to determine students' status with respect to educational variables of interest” (Popham, 2014, p. 8). In school, the educational variable of interest most often is student achievement in different areas (e.g., reading, writing, mathematics, science).

Student achievement always has been critical, but its importance has been underscored in recent years by legislation and standards. For example, the federal government's No Child Left Behind (NCLB) Act of 2001 (Shaul & Ganson, 2005) has many provisions. Among

the most significant are the requirements for annual testing of students in grades 3 through 8 and again in high school in reading and mathematics and for school systems to show increases in students making adequate yearly progress in these subjects. *The Common Core State Standards for English Language Arts and Mathematics* (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010; White & DiBenedetto, 2015), which are designed to promote college and career readiness, were adopted by many states. The Every Student Succeeds Act of 2015 made several changes to NCLB's provisions including giving states freedom to select their goals for test proficiency, English language proficiency, and graduation rates. However, states remain accountable to the federal government, and their accountability systems must include at least four indicators: proficiency on state tests, English language proficiency, a third academic indicator, and one other indicator such as student engagement and postsecondary readiness. Collectively, these standards and legislation ensure that accountability for student learning will continue to receive attention.

Two points are noteworthy with respect to this text. Although accountability often leads to testing being the means of assessment, the latter includes many measurement procedures besides testing (described below). Researchers and practitioners want to know whether learning has occurred, and there may be procedures other than testing that provide evidence of student learning (Popham, 2014). Second, students' skills in content areas often are the learning outcomes assessed, but researchers and practitioners may also be interested in other forms of learning. For example, they may want to know whether students have learned new attitudes or self-regulation skills or whether students' interests, values, self-efficacy, and motivation have increased as a result of content learning.

This section covers ways to assess outcomes of learning. These methods include direct observations, written responses, oral responses, ratings by others, and self-reports (Table 1.3).

Table 1.3
Methods of assessing learning.

Category	Definition
Direct observations	Instances of behavior that demonstrate learning
Written responses	Written performances on tests, quizzes, homework, papers, and projects
Oral responses	Verbalized questions, comments, and responses during learning
Ratings by others	Observers' judgments of learners on attributes indicative of learning
Self-reports	People's judgments of themselves
■ Questionnaires	Written ratings of items or answers to questions
■ Interviews	Oral responses to questions
■ Stimulated recalls	Recall of thoughts accompanying one's performances at given times
■ Think-alouds	Verbalizing aloud one's thoughts, actions, and feelings while performing a task
■ Dialogues	Conversations between two or more persons

- Driscoll, M. P., 207, 210
 Driver, R., 273, 318
 Drum, P., 203
 Dubinsky, J. M., 31, 70
 DuBois, D. L., 153, 494
 Duchastel, P., 110
 Duda, J. L., 412
 Duell, O. K., 261, 262, 264
 Dufresne, R., 285
 Dunbar, K. N., 286
 Duncan, R. M., 320, 322, 337
 Duncker, K., 202, 275, 277
 Dunham, P., 99
 Dunlosky, J., 233
 Dunn, R., 499
 Dunning, D., 187
 Dunsmore, K., 193
 Dupeyrat, C., 387
 Durik, A. M., 406
 Durkin, M., 8
 Dusek, J. B., 470
 Dweck, C. S., 103, 115, 152, 261, 376, 385,
 392, 393, 394, 395, 396, 397, 402,
 409, 447, 448

 Early, D. M., 485
 Easter, M. A., 393, 395
 Easton, J. Q., 476, 477, 492, 493
 Ebbeck, V., 137
 Ebbinghaus, H., 8, 170, 171, 232
 Eby, L. T., 163
 Eccles, J., 305
 Eccles, J. S., 150, 375, 376, 377, 378, 450,
 451, 473, 475, 477, 478, 482
 Edgington, C., 21, 23
 Efklides, A., 260, 448
 Egeland, B., 482, 483, 487
 Eggen, T. J. H. M., 293, 294
 Elder, G. H., 478
 Elder, J. H., 173
 Elkind, D., 351
 Elliot, A. J., 373, 375, 392, 393, 394,
 395, 449
 Elliott, E. S., 376, 392, 394, 395
 Ellis, S., 142
 Elstein, A. S., 285
 Ely, K., 417, 418
 Emmer, E. T., 467
 Emmons, C. L., 488, 489
 Enders, C., 304
 Engel, M., 485
 Engelhard, C., 293, 299, 300
 Engels, R. C. M. E., 296
 Engle, R. W., 189, 191
 Englund, M. M., 487
 Ennemoser, M., 490
 Ennis, R. H., 285, 287
 Epstein, J. L., 467, 468
 Erdelyi, M. H., 8
 Erickson, F., 13
 Erickson, G. A., 219
 Ericsson, K. A., 207, 254, 255, 339
 Ertmer, P. A., 207, 210, 292, 386, 394, 424,
 430, 448, 452
 Escribe, C., 387
 Espinoza, G., 479, 482, 483
 Estell, D. B., 483
 Estes, W. K., 172, 231
 Evans, J. D., 180
 Evans, R. B., 8
 Evans, S. H., 453
 Evenson, D. H., 305
 Evertson, C., 467
 Evrard, M. R., 33, 34, 38, 49
 Eylon, B., 257, 273
 Eysink, T. H. S., 297

 Fabos, B., 301
 Falmagne, R. J., 289
 Fan, X., 487
 Fantuzzo, J. W., 162, 343, 485
 Farmer, L., 297
 Farmer, T. W., 483
 Farnham-Diggory, S., 201, 204
 Farr, M. J., 284
 Faw, H. W., 205, 206
 Feather, N. T., 373
 Felde, M., 31, 34, 38, 40, 47, 49, 64, 65, 70
 Feldlaufer, H., 477
 Feldman, J., 173, 174
 Feldman, N. S., 387
 Feldon, D. F., 211
 Felton, G., 157
 Feltovich, P. J., 257, 285
 Feltz, D. L., 156, 158
 Fenesi, B., 189
 Fennell, S., 297
 Fennema, E., 385
 Ferguson, M., 57
 Ferguson, M. J., 94
 Fernyhough, C., 338
 Ferrara, R. A., 333, 335
 Ferster, C. S., 100
 Feskens, R. C. W., 293, 294
 Festinger, L., 365, 387, 425
 Fida, R., 429, 430
 Filges, T., 484
 Fillmore, L. W., 223
 Finch, H., 379
 Fincham, J. M., 283, 302
 Finelli, R., 244
 Finkel, E. J., 447
 Finn, J. D., 493
 Fiorella, L., 296, 297
 Fischer, F., 191
 Fischer, K. W., 325
 Fiset, M., 301
 Fitneva, S. A., 229
 Fives, H., 157, 469
 Flamm, E. S., 483
 Flavell, E. R., 261
 Flavell, J. H., 258, 261, 264, 324
 Fleming, J. S., 399
 Fletcher, J. D., 295
 Fletcher, S., 163, 255
 Floden, R. E., 22
 Flojo, J., 308
 Flynn, E. G., 140, 142, 154
 Foehr, U. G., 489
 Foley, M. A., 335
 Ford, D. Y., 223
 Ford, M. T., 405
 Forgas, J., 64, 406, 407
 Forget, J., 114
 Fouad, N. A., 151
 Fox, M. C., 339
 Fox, N. A., 40, 67, 69
 FPG Child Development Institute, 485
 Francis, W. D., 384
 Franks, J. J., 179, 188
 Frauenglass, M. H., 338, 340
 Freedman, S. W., 336
 Freiberg, H. J., 370
 Frieber, S. E., 184
 Friedman, D. E., 402
 Friedman, R., 392
 Friend, R., 385
 Frieze, I. H., 383, 384
 Fryer, J. W., 449
 Fuchs, D., 244, 267, 343
 Fuchs, L. S., 244, 343
 Fukkink, R. G., 142
 Fung, W., 191
 Furth, H. G., 319
 Fuson, K. C., 338
 Fyfe, E. R., 308

 Gabbard, R., 297
 Gaelick, L., 428
 Gage, F., 33
 Gage, N. L., 22
 Gagné, F., 114
 Gagné, R. M., 207, 208, 209, 210,
 268, 269
 Gaillard, V., 191
 Gais, S., 68
 Gaither, S. M., 410
 Galanski, E., 482
 Galanter, E., 433
 Gallindo, C., 484
 Gallimore, R., 337
 Gallo, D. A., 222
 Ganson, H. C., 14, 112
 Garcia, T., 395, 451
 Garcia-Reid, P., 477
 Garland, J., 453
 Garland, J. C., 440
 Garmezy, N., 488
 Gates, A. I., 83
 Gaulin, J. P., 292

- Gauvain, M., 496
 Gavelek, J. R., 193
 Gavins, M., 455
 Gazzaniga, M., 36, 38, 189
 Ge, X., 298
 Geary, D. C., 3, 306, 306–307, 307, 332, 336, 337
 Gebhardt, W., 159
 Gebreyesus, S., 489
 Geddes, D., 457
 Gelade, G., 183
 Gentner, D., 242
 George, T. R., 156
 Gepshtein, S., 173, 174
 Gerjets, P., 297
 Gersten, R., 295, 308
 Geschwind, N., 52
 Gest, S. D., 485, 488
 Gheen, M. H., 452
 Gibson, E. Jr., 480
 Gick, M. L., 282
 Gilbertini, M., 159
 Gilbertson, L., 492, 493
 Gill, S., 485
 Gimbirt, B. G., 21
 Gimpert, N., 335
 Gingras, I., 403, 404, 405
 Ginsburg, H., 319
 Ginsburg-Block, M. D., 162, 343
 Girgus, J. S., 401
 Gitomer, D. H., 433
 Glaser, C., 455
 Glaser, M., 297
 Glaser, R., 22, 208, 253, 257, 274, 278, 284, 285, 303, 433
 Glasgow, K. L., 385
 Glasgow, R. E., 159
 Glenn, C. G., 226
 Glenn, J., 305
 Glogger, I., 455
 Glover, J. A., 179
 Glynn, S. M., 111
 Gobbo, C., 325
 Goble, F. G., 367
 Godbole, N., 243
 Goddard, R. D., 158
 Godden, D. R., 219
 Godding, P. R., 159
 Goetz, T. E., 224
 Goicoechea, J., 315
 Golan, S., 153, 395, 397
 Goldin-Meadow, S., 4, 269, 442
 Goldman-Fraser, J., 495
 Goldstone, R., 181
 Gomez, L., 305
 Gonida, E. N., 451
 Gonsalves, J., 289
 Gonzales, M. A., 118
 Gonzalez, A-L., 476
 Gonzalez-DeHass, A. R., 487
 Good, T. L., 470, 471, 477, 498
 Goodenough, D. R., 500
 Goodman, J., 136, 137, 502
 Goodnow, J., 267, 268
 Gopal, A., 233
 Gopnik, A., 341
 Goshen-Gottstein, Y., 190
 Gottfried, A. E., 399
 Gottfried, A. W., 399
 Gould, D., 156
 Grabe, M., 186
 Grabner, R., 43
 Graesser, A. C., 294
 Graham, S., 153, 266, 361, 381, 383, 385, 386, 395, 397, 401, 454, 455
 Granic, I., 296
 Graves, A. W., 422
 Graves, M. F., 111
 Gredler, M. E., 330, 331, 333, 334
 Green, C. D., 10
 Green, F. L., 261
 Greenberg, D., 453, 454
 Greenberg, M. T., 485
 Greene, B. A., 194
 Greene, D., 404, 405
 Greene, J. A., 18, 263, 417, 418, 433, 440, 443
 Greenfield, P., 327
 Greenfield, P. M., 327
 Greeno, J. G., 314, 318
 Gregory, S., 65
 Greiff, S., 284
 Griffin, M. M., 247, 318
 Grigorenko, E. L., 499, 500, 502, 503
 Grimaldi, P. J., 218, 245, 246
 Grolnick, W. S., 402, 483
 Grossen, B., 282
 Guay, F., 379
 Gunn, T. P., 340
 Gunnar, M. R., 66
 Gupta, P., 197, 201
 Gupta, S., 263
 Gurland, S. T., 402
 Guskey, T. R., 158
 Guthrie, E. R., 89, 90, 91, 93
 Guthrie, J. T., 267, 298
 Haarmann, H. J., 190
 Habib, F., 489
 Hacker, D. J., 304
 Hackett, G., 152, 160
 Hadwin, A., 419
 Hadwin, A. F., 294, 419
 Hadwin, A. R., 433, 442
 Haertel, E., 21
 Hagen, J. W., 261
 Hakel, M. D., 247
 Halgren, E., 64
 Hall, D., 191
 Hall, R. H., 236, 271
 Hall, R. J., 417, 418
 Hall, V., 386
 Hall, V. C., 10
 Hallahan, D. P., 107, 339, 422
 Hallicday, A. M., 57, 286
 Halpern, D. F., 247, 282
 Hamilton, R. J., 110
 Hamlett, C. L., 244
 Hamre, B. K., 22, 23, 470
 Hancock, C. R., 223
 Hannus, M., 274
 Hansen, C., 282
 Hanson, A. R., 142, 154, 155, 426, 430
 Hanusa, B. H., 384
 Harackiewicz, J., 406, 407
 Harackiewicz, J. M., 146, 375, 395, 406
 Harari, O., 380, 411
 Hardiman, P. T., 285
 Harkins, S. G., 430
 Harlow, S., 315
 Harris, B., 88
 Harris, J. A., 85
 Harris, J. R., 483, 486
 Harris, K. R., 265, 266, 401, 442, 443, 454, 455
 Harter, S., 398, 399
 Hartley, E. T., 142
 Hasselhorn, M., 192
 Hastings, J. T., 113
 Hattie, J., 97, 147, 153, 395, 442
 Hau, K., 390
 Haviland, S. E., 220, 227
 Hawkins, J. A., 482
 Hayes, J. R., 455
 Hayes-Roth, B., 197, 229
 Haynes, N. M., 488, 489
 Haywood, H. C., 332, 334, 341, 342
 Heatherston, T. F., 32, 64
 Hebb, D. O., 48
 Heckhausen, H., 449
 Hedges, L. V., 4
 Hegarty, M., 308
 Heidbreder, E., 4, 9, 79
 Heider, F., 364, 382, 384
 Heiser, J., 297
 Heiser, W. J., 307
 Hélie, S., 275
 Henderlong, J., 403, 404, 405
 Henderson, J. G., 349
 Henderson, R. W., 444, 445
 Hennessey, B. A., 291
 Henson, R. K., 158
 Herald-Brown, S. L., 478, 479
 Herring, W., 492, 493
 Herzog, L., 493
 Hetherington, E. M., 483, 487
 Heward, W. L., 47, 227
 Hickendorff, M., 307
 Hidi, S., 406, 407
 Hidi, S. E., 449

- Higgins, E. T., 387
 Highet, G., 22
 Hilbert, T., 302
 Hilgard, E. R., 4, 80, 82, 83
 Hill, N. E., 487, 488
 Hill, T., 485
 Hinkley, J., 495
 Hirsch, E. D., Jr., 239
 Hirt, E. R., 219
 Hismjatullina, A., 177
 Hitchcock, C. H., 142
 Hmelo-Silver, C. E., 305, 353
 Hoa, L. W., 450, 451
 Hoard, M. K., 306–307
 Hodell, M., 296, 403, 405
 Hofer, B. K., 452
 Hofferth, S. L., 491
 Höffler, T. N., 236
 Hogan, D., 157
 Hogan, D. M., 344
 Hoke-Sinex, L., 487
 Holland, J. G., 94, 115
 Hollandsworth, J. G., 442
 Holley, C. D., 440, 453
 Hollis, K. L., 87
 Holyoak, K. J., 278, 282, 283
 Holzapfel, L., 455
 Hom, H. L., Jr., 147
 Homer, B. D., 295, 296
 Homme, L., 118
 Honigsfeld, A., 499
 Hooppe, C., 135
 Hopkins, S. L., 307
 Horn, C., 454
 Horner, R. H., 106
 Horner, S. L., 135, 410
 Hornyak, R. S., 420, 421
 Horowitz, F. D., 79
 Horton, N., 177
 Horvath, J. A., 256
 Hosp, M., 244
 Houts, R., 497
 Howard, J. H., Jr., 236
 Howard, M. W., 172
 Howe, A., 386
 Hoy, W. K., 157, 158
 Hoyle, R. H., 393
 Huang, B., 301
 Huang, S., 144, 146
 Hubbard, J. J., 488
 Hübner, R., 182
 Hübscher, R., 333, 335
 Hudley, C., 386
 Hughes, C. A., 221
 Huie, F. C., 457
 Hull, C. L., 94, 363
 Hulleman, C. S., 377
 Hung, W., 243
 Hunt, E., 201, 203, 282, 287
 Hunt, H. D., 489
 Hunt, J. McV., 399
 Hunt, M., 4, 79, 85
 Hunter, A. B., 336
 Hurley, M. M., 456
 Hutchinson, J. M., 419
 Huttenlocher, J., 4
 Hymel, S., 482, 483
 Hyönä, J., 274
 Hyslop-Margison, E. J., 315
 Inhelder, B., 319
 Irons, G., 88
 Isaksen, S. G., 291, 292
 Israel, G. D., 493
 Ivry, R., 36, 189
 Iyengar, S. S., 398, 403
 Jackson, S. J., 307
 Jacob, K. F., 402
 Jacobson, L., 470, 471
 Jacoby, L., 178
 Jacoby, L. L., 180
 Jagacinski, C. M., 380, 395
 Jairam, D., 295
 James, W., 10, 130, 449
 Jancek, D., 244
 Jang, H., 403
 Jannings, L. R., 263
 Janson, M., 38
 Jarrold, C., 191
 Järvelä, S., 294, 419
 Jayanthi, M., 308
 Jeffery, R. W., 134
 Jenkins, A. C., 135
 Jensen, E., 32, 34, 38, 53, 54, 56, 57, 62, 63
 Jensen, G., 108
 Jensen, J. L., 269
 Jensen, S., 85
 Jiao, Z., 482
 Jimerson, S., 482, 483
 Jiwani, N., 430
 Johnson, A., 85
 Johnson, A. M., 457
 Johnson, C. I., 297
 Johnson, D. M., 392
 Johnson, M. H., 184
 Johnson, M. K., 198–199, 478
 Johnson, N. S., 236
 Johnson, W. B., 163
 Johnson-Laird, P. N., 287, 289, 290
 Johnston, M. B., 442
 Jonassen, D. H., 116, 243, 292, 293, 294
 Jones, B. D., 406
 Jones, M. H., 479
 Jones, S. H., 273
 Jonker, T. R., 230
 Jonkmann, K., 375, 377
 Jordan, W. J., 493
 Jørgensen, A-M. K., 484
 Jourden, F. J., 396
 Joussemet, M., 291
 Jussim, L., 470, 471
 Just, M. A., 223, 225
 Justice, E. M., 263
 Justice, L. M., 4
 Juvonen, J., 477, 478, 479, 482, 483
 Kagan, J., 502
 Kahana, M. J., 172
 Kail, R., 228
 Kail, R. B., Jr., 261
 Kaiser, M., 257
 Kalantzi-Azizi, A., 482
 Kalish, D., 148
 Kalkman, D. L., 470
 Kalyuga, S., 161, 162, 284, 285, 298
 Kane, M. J., 191
 Kanfer, F. H., 184, 428
 Kanfer, R., 184, 450
 Kanso, R., 40
 Kaplan, A., 480
 Karabenick, S. A., 451
 Kardash, C. A. M., 194
 Kardash, C. M., 144
 Karoly, P., 160
 Karpicke, J. D., 218, 233, 245, 246
 Karpinski, A., 300
 Karpov, Y. V., 332, 334, 341, 342
 Kartal, G., 297
 Katona, G., 192, 276
 Katzir, T., 69
 Kauffman, D. F., 153, 199, 298
 Keating, T., 429
 Keefe, K., 482
 Keele, S. W., 188
 Keen, R., 274
 Kehle, T. J., 142
 Kelleher, R. T., 104
 Keller, F. S., 105
 Kelly, S., 57
 Kempermann, G., 33
 Kendal, R. L., 140, 142, 154
 Kerr, M. M., 106, 155, 343
 Kerst, S. M., 236
 Kester, L., 211
 Ketterlin-Geller, L. R., 455
 Kewal Ramani, A., 492, 493
 Key, A. F., 57
 Khazanchi, S., 291, 405
 Khemlani, S., 289
 Kiefer, S. M., 479
 Kiewra, K. A., 199, 295
 Kihlstrom, J. F., 390
 Kilgour, A. R., 79
 Killingsworth, S. S., 296
 Kim, E. J., 403
 Kim, J. A., 189
 Kimchi, R., 173, 174
 Kimmerle, J., 299, 300
 Kindermann, T. A., 480, 481

- King, E. W., 494
 King, R. B., 494, 495
 Kinlaw, C. R., 495
 Kintsch, W., 195, 225, 307
 Kinzer, C. K., 295, 296
 Kirkland, K., 442
 Kirkorian, H. L., 490, 491
 Kirschner, F., 211
 Kirschner, P. A., 211, 352
 Kirshner, P., 300
 Kistner, J. A., 127, 385, 401
 Kitsantas, A., 417, 432, 455, 457
 Kiuhara, S., 455
 Kjølgaard, M. M., 430
 Klahr, D., 258, 352
 Klahr, K., 305
 Klassen, R., 361, 455, 495, 496
 Klauda, S. L., 139, 149, 267, 375, 377, 378, 380, 450, 451
 Klauer, K. J., 289
 Klausmeier, H. J., 269
 Klint, K. A., 138
 Kluger, J., 52, 291
 Knapp, R. J., 191
 Kneedler, R. D., 107, 339
 Knifsend, C., 478, 479, 482, 483
 Kochel, K. P., 478, 479
 Koedinger, K. R., 295, 302
 Koenig, M. A., 134
 Koestner, R., 291, 403
 Koffka, K., 173, 174
 Köhler, W., 173, 174, 276
 Köller, O., 406
 Kolloffel, B., 297
 Kolodner, J. L., 282
 Konrad, M., 47, 227
 Kopp, C. B., 445
 Kosiewicz, M. M., 422
 Koskey, K. L. K., 407
 Kosovich, J. J., 377
 Kosslyn, S. M., 195, 236, 237
 Kounin, J. S., 466
 Kovach, R., 425, 429
 Kowalski, P. S., 402
 Kozulin, A., 331
 Krakovsky, M., 396
 Kramarski, B., 337
 Kramer, L. J. C., 142
 Krämer, N. C., 298
 Krampe, R. T., 207
 Krapp, A., 406
 Kratochwill, T. R., 419
 Krawec, J., 304
 Krisak, N., 118
 Kross, E., 339
 Kubovy, M., 173, 176
 Kuhl, J., 375, 449, 450, 451
 Kuhn, D., 260, 261, 341
 Kukla, A., 383, 384
 Kulhavy, R. W., 115, 116, 205, 206
 Kulik, C. C., 114, 116
 Kulik, J. A., 114, 116, 295
 Kummer, T.A., 269
 Kürschner, C., 211
 Kurth-Nelson, Z., 85
 Kurtz-Costes, B., 495
 Ladd, G. W., 478, 479, 481, 482
 Lajoie, S. P., 255, 256
 Lam, R., 135
 Laming, D., 173
 Lampert, M., 336
 Lan, W. Y., 301, 420, 425, 453
 Lange, P. C., 116
 Lanzi, R. G., 485
 Larkin, J. H., 257
 Larose, S., 379
 Larrauri, J. A., 85
 Larreamendy-Joerns, J., 292, 301
 Latham, G. P., 118, 119, 143, 144, 145, 146, 392, 427, 450, 504
 Lattal, K. A., 94
 Lau, S., 157
 Lauer, P. A., 112
 Laursen, S. L., 336
 Lave, J., 463
 Lawson, M. J., 307
 Lazar, I., 485
 Leach, J., 273, 318
 Leadbitter, K., 177
 Lebiere, C., 196, 197, 201, 204
 Lederman, N., 386
 Ledford, J. R., 140
 Lee, F. J., 302
 Lee, H., 295, 296
 Lee, J., 476, 487
 Lee, V. E., 476, 477
 Lee, W., 61, 62
 Leeper, R., 174
 Lefcourt, H. M., 382
 LeFevre, J., 226, 487
 Leggett, E. R., 392, 395, 396, 397, 402
 Lehle, C., 182
 Lehman, M., 176, 177, 192
 Lehman, S., 406
 Leinhardt, G., 292, 301
 Lemonick, M. D., 53, 63, 65, 275
 Lent, R. W., 153, 160
 Leopold, C., 297
 Lepper, M. R., 296, 366, 398, 403, 404, 405, 421
 Lesgold, A.M., 95
 Letgers, N. E., 493
 Leung, K. C., 162
 Leung, M. C., 483
 Levin, J., 465, 466, 467
 Levin, J. R., 235
 Levine, S. C., 4
 Levinson, S., 88
 Lewandowsky, S., 230
 Lewin, K., 497
 Lewis, M. W., 303
 Li, Q., 292, 293
 Licht, B. G., 127, 385, 401
 Lichtenfeld, S., 305
 Lienemann, T. O., 455
 Lignugaris/Kraft, B., 162
 Lilienfeld, S. O., 67
 Lim, S., 157
 Lim, S. A., 477
 Lin, C-H., 294
 Lin, L., 60
 Linebarger, D. L., 490
 Link, M., 8
 Linn, M., 305
 Linn, M. C., 257, 273
 Linnenbrink, E. A., 394
 Linnenbrink-Garcia, L., 261, 393, 395, 406, 407
 Lipowski, S. L., 233
 Lippitt, R., 497
 Lipson, M. Y., 197, 201, 259
 Littlefield, J., 220
 Liu, Q., 295
 Liu, X., 301
 Lloyd, J., 422
 Lloyd, J. W., 107, 339
 Lobel, A., 296
 Locke, E. A., 118, 119, 143, 144, 145, 146, 392, 427, 450, 504
 Lockhart, R. S., 178
 Loebl, J. H., 387
 Loewenstein, J., 242
 Loftus, E. F., 200, 222
 Logan, G. D., 183
 Lombardi, D., 273
 Long, A., 386
 Long, G. M., 187
 Long, M. H., 406
 Lonn, S., 297
 Looney, L. B., 477, 478
 Lord, H., 112, 494
 Lord, R. G., 417, 418
 Lou, Y., 301
 Loughlin, S. M., 263
 Lovaaas, O. I., 105
 Love, S. Q., 159
 Lubienski, S. T., 305, 336
 Luchins, A. S., 275, 277
 Luckner, A. E., 487
 Lüdtke, O., 375, 377, 390, 406
 Ludvik, M. J. B., 31, 33, 34, 38, 44, 49
 Luppescu, S., 476, 477, 492, 493
 Luria, A. R., 338
 Lutkehaus, N. C., 327
 Luu, P., 62
 Lynch, E. B., 267
 Lysynchuk, L. M., 243, 255, 273, 434, 442
 Lyxell, B., 191

- Ma, W., 295
 Ma, X., 292, 293
 Maag, J. W., 100
 Mabbott, D. J., 307
 Mac Iver, D., 477, 493
 MacArthur, C., 454, 455
 Maccoby, E. E., 483, 487
 MacDonald, M. C., 225
 Mace, F. C., 417, 419, 421, 422, 423
 MacLeod, C. M., 230
 Madaus, G. F., 113
 Madden, A., 443
 Maddux, J. E., 159
 Maeda, Y., 247
 Maehr, M. L., 392, 394
 Maes, S., 159, 160
 Mager, R., 109
 Magnifico, A. M., 455
 Mahoney, J. L., 112, 494
 Maier, S. F., 400
 Malczynski, R. J., 115, 116
 Malmberg, K. J., 176, 177
 Manderlink, G., 146
 Mandinach, E. B., 450
 Mandler, J. M., 226, 236
 Mangun, R., 36, 189
 Manning, M. A., 107
 Marchant, H., III, 307
 Marcovitch, S., 191
 Marcus, N., 48
 Marini, Z., 325
 Marinkovic, K., 64
 Markman, A. B., 188
 Marks, M. B., 442, 443
 Markus, H., 390, 451
 Marsh, E. J., 243
 Marsh, H. W., 375, 377, 389, 390, 391, 406
 Marshall, H. H., 465
 Martin, A. J., 469
 Martin, J., 447
 Martin, V., 243, 255, 273, 434, 442
 Martinez-Pons, M., 263, 430, 452
 Martin-Glenn, M. L., 112
 Marx, R. W., 273
 Mashburn, A. J., 4
 Maslow, A. H., 366, 367, 368
 Mason, L. H., 266, 401, 455
 Masten, A. S., 483, 488
 Master, A., 395, 396, 407, 448, 477
 Mastropieri, M. A., 191
 Mathes, P. G., 343
 Matlin, M. W., 169, 170, 178, 182, 187, 188,
 192, 193, 201, 203, 204, 218, 223,
 233, 234, 236, 259, 281
 Mautone, P. D., 206, 297
 May, S., 292
 Mayer, R. E., 80, 83, 169, 170, 181, 186, 199,
 205, 206, 210, 211, 273, 281, 284,
 292, 295, 296, 297, 302, 307, 308,
 354, 434, 435, 438, 439, 441, 453
 Mayer, S., 297
 Mayers, R. S., 112
 Mayrath, M. C., 295
 McCandliss, B. D., 43, 44, 62
 McCaulley, M. H., 500
 McClelland, J. L., 204
 McCloskey, M., 257
 McCollam, T. L., 480
 McCombs, B. L., 470
 McCormick, C. B., 253, 260, 265, 442
 McCormick, D., 118
 McCullagh, P., 137, 138
 McDaniel, M. A., 269
 McDermott, J., 257
 McDermott, P. A., 485
 McDonald, B. A., 440, 453
 McDonald, H. E., 219
 McDougall, P., 482, 483
 McDougall, W., 130
 McGregor, H. A., 392, 394
 McInerney, D. M., 494, 495, 496
 McKeachie, W. J., 80
 McKeown, D., 455
 McKim, C., 153
 McLaren, B. M., 295, 302
 McNeil, J. D., 137, 265, 439
 McPartland, M. M., 493
 McVee, M. B., 193
 Meca, A., 67
 Medin, D. L., 267, 268
 Medway, F. J., 402
 Meece, J. L., 184, 221, 267, 321, 323, 325,
 332, 361, 362, 371, 372, 378, 379,
 380, 385, 392, 393, 395, 406, 407,
 449, 463, 465, 466, 472, 473, 475,
 483, 484, 486
 Meichenbaum, D., 107, 135, 136, 137, 339,
 422, 441, 502
 Meltzoff, A. N., 407, 477
 Mergler, A., 402
 Merkel, S., 386
 Merrill, M. M., 302, 303, 304
 Merrill, P. F., 208
 Messer, S., 502
 Messersmith, E. E., 406
 Messick, S., 499, 503
 Mestre, J. P., 240, 285
 Metcalfe, J., 261
 Mevarech, Z. R., 337
 Mewborn, D. S., 305, 336
 Meyer, D. E., 200
 Meyer, D. K., 394, 404
 Mickelson, R., 150
 Middle School Mathematics
 Through Applications Project
 Group, 318
 Middleton, M. J., 393, 395
 Midgley, C., 451, 452, 473, 475, 477
 Miele, D. B., 261, 411
 Miliotis, D., 488
 Miller, A. T., 395, 411
 Miller, G. A., 177, 189, 192, 227, 433
 Miller, K., 305
 Miller, M., 419
 Miller, M. D., 107
 Miller, N. E., 126, 131
 Miller, P. H., 243
 Miller, S. D., 267
 Miller, T. R., 162, 343
 Miller-Johnson, S., 486
 Mitchell, M., 407
 Mix, K., 305
 Miyake, A., 223, 225
 Miyatsu, T., 230
 Molden, D. C., 396, 397
 Molfese, D. L., 57
 Molfese, V. J., 57
 Moll, L. C., 334, 335, 341, 397
 Moller, A. C., 402
 Monk, C. A., 308
 Montague, M., 304
 Moody, T. D., 60
 Moore, C. A., 500
 Moore, M. T., 285
 Moors, A., 202
 Moos, D. C., 153, 296, 298, 443, 457
 Moreno, R., 274, 295, 297
 Morgan, P. L., 267
 Moritz, S. E., 158
 Morphy, P., 308
 Morra, S., 325
 Morris, C. D., 179
 Morris, E. K., 93, 94
 Morris, R. G. M., 32, 49
 Morrison, F. J., 497
 Morrison, R. G., 283
 Morrow, D. G., 226
 Morse, W. H., 104
 Mortimer, E., 273, 318
 Mosatche, H. S., 388
 Moscovitch, M., 179
 Moser, J., 339
 Moshman, D., 260, 263
 Moskaliuk, J., 299, 300
 Moss, H. A., 502
 Motl, R. W., 157
 Mudrick, N., 293, 294
 Mueller, M. P., 325
 Muenks, K., 411
 Muldner, K., 135
 Mullen, C. A., 143, 163, 255, 336
 Multon, K. D., 153
 Munroe, R. L., 496
 Murayama, K., 230, 305, 392,
 393, 394
 Murdock, T. B., 395
 Murphy, C. C., 148
 Murphy, K., 284
 Murphy, M. D., 147
 Murphy, P. K., 398

- Murphy, R. F., 489
 Murray, D. J., 79
 Murray, H., 485
 Muth, K. D., 111
 Myers, I. B., 500
 Myers, M., II, 262
- Nagengast, B., 375, 377
 Naglieri, J., 441
 Nagy, G., 375, 377, 390
 Nairne, J. S., 178, 190, 200, 231
 Nandagopal, K., 254, 255
 Nation, K., 191
 National Governors Association
 Center for Best Practices and
 Council of Chief State School
 Officers, 15
 National Research Council, 32, 49, 58, 238,
 240, 274, 284, 305, 477, 492, 493
 National Research Council & Institute of
 Medicine, 494
 Natriello, G., 477
 Neal, D. T., 90
 Neale, J., 385
 Neath, I., 170, 178, 180, 218, 220, 226, 230,
 231, 234, 244
 Neckerman, J. J., 480, 483
 Neisser, U., 183
 Neitzel, C., 487
 Nelson, J. B., 87
 Nelson, K. E., 485
 Nelson, T. O., 180
 Nesbit, J. C., 210, 271, 295, 297
 Neumeister, K. L. S., 379
 Neuringer, A., 108
 Newcombe, N. S., 305
 Newell, A., 278, 280, 284, 289, 290
 Newman, R. S., 451, 452, 483
 Ng, W., 292, 293, 294, 298, 299
 Nicholls, J. G., 380, 381, 393, 395, 397,
 411, 412
 Nicklin, J. M., 405
 Nie, Y., 157
 Nielsen, M., 140
 Nietfeld, J. L., 261, 296, 490, 491
 Nihalani, P. K., 295
 Nisbett, R. E., 404, 405
 Nix, R. L., 485
 Noddings, N., 477
 Nokes, J. D., 304
 Nokes-Malach, T. J., 240, 263
 Nolan, J. F., 465, 466, 467
 Nolen, S. B., 395, 397
 Nolen-Hoeksema, S., 401
 Norby, M. M., 173, 211, 232, 233, 239, 284,
 286, 303, 307, 316, 317, 332
 Norman, D. A., 183, 203
 Nückles, M., 455
 Nugent, L., 306–307
 Numtee, C., 306–307
- Nurius, P., 390, 451
 Nussbaum, E. M., 144
- Oberauer, K., 230
 O'Boyle, E. H., 447
 O'Day, E. F., 115, 116
 Oden, S., 485
 O'Donnell, A. M., 236, 247, 271, 313, 336
 Oeberst, A., 299, 300
 Ohlsson, S., 254, 255, 269, 273
 Oka, E. R., 441
 O'Keefe, P. A., 393, 395
 O'Leary, K. D., 102
 Olney, A., 294
 Olson, K. R., 152
 Olver, R. R., 327
 O'Mara, A. J., 391
 Omelich, C. L., 380
 Oostdam, R., 267
 Opfermann, M., 297
 Oppen, S., 319
 Ornstein, R., 39, 40
 Osborn, A. F., 292
 Osterman, K., 477, 479
 Oswald, F. L., 184
 Otter, M. E., 267
 Overmaat, M., 267
 Overskeid, G., 94
 Owen, R., 244
 Ozogul, G., 274
- Paas, F., 43, 48, 162, 210, 211, 225, 284,
 285, 303
 Packer, M. J., 315
 Padilla, A. M., 223
 Pai, H-H., 247
 Paivio, A., 151, 233, 234, 236, 302
 Pajares, F., 151, 152, 153, 273, 382, 386,
 389, 391, 429, 432
 Palincsar, A. S., 265, 266, 343, 436
 Palmer, D. R., 454
 Palmer, S. E., 173
 Palmere, M., 179
 Pan, S. C., 233
 Papini, M. R., 87
 Paquette, L., 19
 Paré-Blagojev, J., 69
 Parente, M. E., 494
 Paris, A. H., 433, 442, 446, 447, 448
 Paris, S. G., 197, 201, 259, 262, 433, 441,
 442, 444, 446, 447, 448
 Park, J., 339
 Park, O., 270, 271
 Pascual-Leone, J., 325
 Pashler, H., 23
 Passaro, P. D., 158
 Pastorelli, C., 154, 160
 Patall, E. A., 247, 406
 Patashnick, M., 397
 Pate, R. R., 157
- Patrick, H., 480
 Patterson, C. J., 421
 Paul, A. M., 52
 Pavlov, I. P., 85, 86, 87, 93, 338
 Peck, K. L., 292, 293
 Pedro, J. D., 385
 Pekrun, R., 64, 305, 407
 Péladeau, N., 114
 Pellegrino, D. A., 293, 299, 300
 Pellegrino, J. W., 22, 287, 288
 Peltier, C., 274
 Pennycook, G., 290
 Perencevich, K. C., 267
 Perin, D., 455
 Perkins, D. N., 238, 240, 241, 242, 243,
 246, 254, 255
 Perry, D. G., 142
 Perry, N. E., 158, 442
 Persampieri, M., 220
 Persson, T., 286
 Peter, N., 385
 Peterson, C., 400
 Peterson, L. R., 189
 Peterson, M. A., 173
 Peterson, M. J., 189
 Peterson, N. A., 477
 Petri, H. L., 369
 Phares, E. J., 382
 Phelps, E. A., 65
 Phillips, D. C., 316
 Phillips, M., 489
 Phye, G. D., 238, 243, 244, 266, 289
 Piaget, J., 131, 317, 319, 473
 Pianta, R.C., 4, 22, 23, 470, 497
 Pichert, J. W., 194
 Pierce, W. D., 404
 Pimperton, H., 191
 Pine, D. S., 43
 Pintrich, P. R., 153, 273, 361, 362, 371,
 378, 380, 386, 392, 393, 394, 395,
 406, 407, 423, 429, 432, 448, 449,
 451, 452, 466, 472, 483, 484, 486
 Piotrowski, J. T., 490
 Plake, B. S., 179
 Plano-Clark, V. L., 13
 Plass, J. L., 295, 296
 Plato, 5, 449
 Poag-DuCharme, K. A., 156, 157
 Pokay, P., 451
 Polk, T. A., 289, 290
 Pollack, J. M., 447
 Polya, G., 277
 Pomerantz, E. M., 479, 486, 488
 Pomerantz, J. P., 236
 Pomerantz, J. R., 173, 174
 Popham, W. J., 14, 15, 20, 118
 Popkewitz, T. S., 9
 Portes, P. R., 495
 Portrat, S., 189
 Posner, M. I., 52, 60, 188

- Postle, B. R., 38, 47
 Postman, L., 228
 Powell, R. A., 88
 Powelson, C. L., 482
 Prater, M. A., 142
 Premack, D., 98
 Prentice, K., 244
 Pressley, M., 243, 253, 255, 265, 273, 434, 442, 443
 Presti, D. E., 36, 44, 49, 61, 64
 Pribham, K. H., 433
 Prochaska, J. O., 159
 Provasnik, S., 492, 493
 Pugh, K. J., 243, 247, 494
 Pungello, E. P., 486
 Puntambekar, S., 333, 335
 Purdie, N., 395, 442
 Putnam, R. D., 483
 Pyc, M. A., 233
 Pylyshyn, Z. W., 236

 Qin, Y., 196
 Quellmalz, E. S., 287
 Quillian, M. R., 196–197
 Quin, D., 469
 Quinn, A., 142

 Radvansky, G. A., 169, 178, 182, 183, 187, 188, 189, 195, 199, 201, 205, 219, 221, 230
 Radziszewska, B., 336
 Raftery, J. N., 483
 Ragland, E. U., 106, 155, 343
 Ramani, G. B., 486
 Ramey, C. T., 485, 486
 Ramey, S. L., 485
 Ramirez, M., 488
 Ramsburg, J. T., 273
 Ramsel, D., 186
 Randall, J. G., 184
 Ratelle, C. F., 379
 Rathunde, K., 404
 Ratner, H. H., 335
 Raudenbush, S. W., 4
 Raugh, M. R., 438
 Rawson, K. A., 233
 Ray, J. J., 375
 Rayner, R., 87
 Raynor, J. O., 373
 Reardon, S. F., 484
 Rechs, J. R., 118
 Reder, L. M., 23, 196, 197, 201, 204, 243, 247, 318
 Redford, J., 438
 Redick, T. S., 191
 Redish, A. D., 85
 Reed, L., 383, 384
 Reed, S. K., 297
 Rees, E., 285
 Reeve, J., 61, 62, 402, 403

 Régner, I., 387
 Reid, M. K., 442
 Reid, R., 422, 455
 Reid, R. J., 477
 Reigeluth, C. M., 211
 Reimann, P., 293, 303
 Reisslein, M., 274
 Relich, J. D., 154
 Renkl, A., 161, 162, 271, 284, 285, 295, 302, 303, 304, 455
 Renkl, D., 302
 Renninger, K. A., 406
 Repucci, N. D., 385
 Rescorla, R. A., 86, 87, 107
 Resnick, L. B., 186, 188, 193, 224, 280, 284, 285, 306, 336, 337
 Rest, S., 383, 384
 Reuman, D., 477
 Reusser, K., 307
 Reyes, M. R., 407
 Reynolds, R., 186
 Reynolds, R. E., 3, 224
 Rheinberg, F., 448
 Rhodes, J. E., 163
 Rhodes, M. G., 259
 Ribes-Inesta, E., 105
 Rice, J. M., 147, 243, 247, 255, 264, 273, 394, 410, 422
 Richardson, K., 305
 Richert, R. A., 490
 Richey, J. E., 263
 Richland, L. E., 283
 Richter, C. P., 362
 Rickard, T. C., 233
 Riefer, D., 282
 Riener, C., 499
 Rijlaarsdam, G., 387
 Rikoon, S. H., 485
 Ringle, J., 154, 426
 Rintamaa, M., 443
 Rips, L. J., 197
 Rissman, J., 40
 Ritchey, G. H., 236
 Ritchie, B. F., 148
 Ritter, P. L., 385
 Rittle-Johnson, B., 247, 308, 337
 Rivers, S. E., 407
 Robb, M. B., 490
 Roberts, B., 179
 Roberts, D. F., 489
 Robertson, J. S., 410
 Robinson, D. H., 295
 Robinson, D. R., 337
 Robinson, F. G., 205
 Robinson, J. C., 247
 Robinson, M., 293
 Robinson, N. M., 485
 Robinson, T. R., 107
 Roblyer, M. D., 292, 293, 296
 Robustelli, S. L., 470, 471

 Roediger, H. L., 233
 Roehrig, G., 31, 70
 Roesser, R. W., 465, 477, 478, 482
 Rogat, T. K., 407
 Rogers, C. R., 369, 370
 Rogoff, B., 142, 333, 336
 Rogowsky, B. A., 503
 Rohrbeck, C. A., 162, 343
 Rohrer, D., 23, 303
 Rohrkemper, M. M., 330
 Rolland, R. G., 393, 407
 Romberg, T. A., 203, 306, 307
 Ronevich, P., 263
 Root-Bernstein, R. S., 352
 Rosas, J. M., 87
 Rosch, E., 187, 188, 268
 Roscoe, R. D., 163
 Rosen, B., 378
 Rosenbaum, R. M., 383, 384
 Rosenberg, M. S., 137
 Rosenholtz, S. H., 466
 Rosenholtz, S. J., 465, 466
 Rosenshine, B., 469, 497
 Rosenthal, R., 470, 471
 Rosenthal, T. L., 130, 131, 133, 136, 322
 Ross, D., 141
 Ross, G., 335, 337
 Ross, S. A., 141
 Ross, S. M., 116, 118, 294
 Roth, G., 403
 Rothbart, M. K., 52, 60
 Rothstein, J., 21
 Rotter, J. B., 381, 384
 Rouder, J. N., 191
 Rowe, M. L., 486
 Rowland, C. A., 233
 Royce, J., 485
 Royer, J. M., 194, 240, 241, 307
 Ruble, D. N., 387, 388
 Rumberger, R. W., 477, 482
 Rumelhart, D. E., 203, 204, 221, 226
 Rummel, N., 162
 Rummer, R., 190
 Rundus, D., 190
 Russel, S. L., 477, 478
 Ryan, A. M., 452, 480, 481
 Ryan, R. H., 379
 Ryan, R. M., 402, 403, 477, 482

 Sabbagh, M. A., 134
 Sadoski, M., 233
 Sage, N. A., 480
 Sagotsky, G., 421
 Sakitt, B., 187
 Sakiz, G., 470
 Salden, R. J. C. M., 295, 302
 Salen, K., 295
 Salisbury-Glennon, J. D., 305
 Salomon, G., 153, 238, 240, 241, 242, 243, 246, 254, 255

- Salonen, P., 419
 Salovey, P., 407
 Samarapungavan, A., 269
 Sana, F., 189
 Sanders, C. E., 243, 244
 Sandoval, J., 273
 Sandoval, W. A., 263
 Santangelo, T., 266, 454, 455
 Saults, J. S., 177, 191
 Saunders, R. P., 157
 Sauvigné, K. C., 67
 Savage, T. V., 347, 350
 Scalise, K., 31, 34, 38, 40, 47, 49, 64, 65, 70
 Scerif, G., 184
 Schaecken, W., 290
 Schallert, D. L., 3, 224
 Schartz, M., 422
 Scheier, M. F., 434
 Scheiter, K., 296, 297
 Schiefele, U., 398, 406
 Schlosberg, H., 362
 Schmajuk, N. A., 85
 Schmid, R. F., 294
 Schmidt, A. M., 417, 418
 Schmidt, M. E., 490, 491
 Schneider, W., 442, 490
 Schnotz, W., 211
 Schoenfeld, A. H., 305
 Schofield, J. W., 337
 Schonert-Reichl, K., 482, 483
 Schraw, G., 260, 263, 294, 406
 Schraw, G. J., 173, 211, 232, 233, 239, 284, 286, 303, 307, 316, 317, 332
 Schuh, K. L., 345
 Schüler, A., 296
 Schulte, A. C., 454
 Schultz, W., 95
 Schulz, L. E., 135
 Schunk, D. H., 26, 119, 126, 127, 128, 129, 130, 135, 136, 142, 143, 144, 145, 146, 147, 150, 151, 152, 153, 154, 155, 157, 161, 162, 163, 203, 243, 244, 246, 247, 255, 259, 264, 273, 305, 318, 339, 340, 341, 344, 361, 362, 371, 378, 380, 381, 382, 385, 386, 387, 389, 390, 391, 392, 393, 394, 395, 399, 400, 402, 405, 406, 407, 410, 411, 417, 418, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 432, 434, 441, 442, 445, 447, 448, 449, 452, 455, 457, 466, 468, 469, 470, 472, 478, 479, 483, 484, 486, 494, 497, 498, 504
 Schvaneveldt, R. W., 200
 Schwaighofer, M., 191
 Schwan, S., 297
 Schwanenflugel, P. J., 261, 265
 Schwartz, B. L., 448
 Schwartz, D. L., 43, 44, 62, 181
 Schwartz, S. J., 67
 Schweinhart, L., 485
 Schweinhart, L. J., 485
 Schwenck, C., 442
 Schweppe, J., 190
 Schwonke, R., 455
 Schworm, S., 302
 Scott, P., 273, 318
 Scrimsher, S., 330, 331, 333, 337, 341
 Scruggs, T. E., 191
 Searle, J. R., 226
 Sears, D. A., 247
 Sears, K. G., 487
 Sebring, P. B., 476, 477, 492, 493
 Sederberg, P. B., 172
 Seibert, D., 298
 Seidel, T., 22
 Seli, H., 436, 438, 440, 442, 444, 452, 453
 Seli, P., 230
 Seligman, M. E. P., 400, 401, 402
 Senécal, C., 379
 Sénéchal, M., 226, 487
 Senko, C., 392, 394
 Seo, K. K-J., 293, 299, 300
 Sesma, A. J., 488
 Sethi, S., 405
 Setliff, A. E., 56
 Settersten, R. A., 489
 Seymour, E., 336
 Shablack, H., 339
 Shagle, S. C., 489
 Shallice, T., 193
 Shanks, D. R., 6
 Shapka, J. D., 158
 Shaul, M. S., 14, 112
 Shavelson, R., 389
 Shavelson, R. J., 22, 151, 389
 Shaw, S. M., 301
 Shea, M. C., 421, 422, 423
 Sheese, R., 325
 Shell, D. F., 148
 Shepard, R. N., 234, 236
 Shiffrin, R. M., 176, 180
 Shipman, S., 499, 502
 Shipman, V. C., 499, 502
 Shipstead, Z., 191
 Shoben, E. J., 197
 Shore, D. L., 189
 Shore, N., 59
 Short, E. J., 184
 Shuell, T. J., 22, 203
 Shulman, L. S., 285
 Shultz, T. R., 366
 Shute, N., 54
 Shute, V. J., 476
 Siddarth, P., 60
 Siegler, R. S., 22, 204, 244, 282, 283, 323, 324
 Sigel, I. E., 501, 502
 Sigelman, C. K., 411
 Silver, E. A., 308
 Simmering, V. R., 191
 Simmons, D. C., 343
 Simon, D. P., 257
 Simon, H. A., 23, 219, 243, 247, 257, 258, 278, 280, 284, 285, 318, 352
 Simone, R., 478
 Simpson, C., 465, 466
 Simpson, T. L., 315, 316
 Sinatra, G. M., 273
 Singh, M., 173
 Sirin, S. R., 483, 484
 Sitzmann, T., 417, 418
 Sivan, E., 318
 Skinner, B. F., 24, 25, 93, 94, 95, 96, 98, 99, 100, 102, 104, 108, 115, 128, 131, 148, 228, 239, 363
 Skinner, E. A., 400
 Slavin, R. E., 267, 336, 343, 344
 Small, G. W., 60, 61
 Small, S. L., 4
 Smith, E. E., 197, 268
 Smith, E. J., 490
 Smith, E. R., 204
 Smith, J. B., 476, 477
 Smith, P. L., 151
 Smith, R. E., 151
 Smith, S. W., 107
 Smithson, C., 88
 Snipper, A., 485
 Snow, D., 112
 Snowman, J., 436, 437, 440
 Snyder, K. E., 261
 Sobko, K., 297
 Solomon, K. O., 267
 Son, L. K., 261
 Spanjers, I. A. E., 236
 Spera, C., 488
 Sperling, G., 186, 187
 Sperry, R., 38
 Spinath, B., 393
 Sprafka, S. A., 285
 Springer, L., 337
 Sroufe, A. A., 482, 483
 Staddon, J. E. R., 94
 Stanne, M. E., 337
 Star, J., 337
 Steca, P., 158
 Steenbergen-Hu, S., 295
 Steers-Wentzell, K. L., 337
 Stein, B. S., 220, 278
 Stein, M., 337
 Stein, N. L., 226
 Steinberg, L., 385, 481, 483, 486, 487
 Steinhauer, M., 182
 Steinmayr, R., 393
 Stella, S., 142
 Stenhoff, D. M., 162
 Stephens, J. M., 465
 Sternberg, R. J., 11, 21, 256, 499, 500, 502, 503

- Sternberg, S., 22, 189, 190
 Stershic, S., 303
 Stevens, A. L., 354
 Stevens, R., 469, 497
 Stipek, D. J., 379, 402, 465
 Stoneman, Z., 142
 Storm, B. C., 230
 Strain, P. S., 106, 155, 343
 Stright, A. D., 487
 Strobel, J., 315
 Strobel, K., 482
 Stull, A. T., 302
 Sugai, G., 106
 Sullivan, P. J., 158
 Suls, J., 387
 Sun, R., 275
 Surkes, M. A., 292, 301
 Surprenant, A. M., 170, 178, 180, 218, 220,
 226, 231, 234, 244
 Swanson, H. L., 184, 191
 Swartz, C. W., 147, 244, 264, 273, 392, 393,
 394, 395, 430, 455
 Sweller, J., 48, 161, 162, 210, 211, 225,
 255, 274, 290, 291, 292, 352, 353
 Sztajn, P., 21, 23

 Taasobshirazi, G., 273
 Taatgen, N. A., 238, 240
 Tabossi, P., 290
 Tallal, P., 503
 Tallent-Runnels, M. K., 301
 Tallis, R., 84
 Tamim, R. M., 292, 294, 301
 Tanner-Smith, E. E., 296
 Tarde, G., 130
 Taub, M., 293, 294
 Tauber, S. K., 259
 Tauer, J. M., 395, 406
 Taylor, A. Z., 381, 385, 386
 Teasdale, J. D., 401
 Tellegen, A., 488
 Tenenbaum, H. R., 354
 Tennyson, R. D., 270, 271
 Terrell, S., 57
 Terry, W. S., 170, 171, 172, 180, 236, 237
 Tesch-Römer, C., 207
 Tesser, A., 453
 Thagard, P., 282
 Tharp, R. G., 337
 Thiede, K. W., 438
 Thomas, J. A., 301
 Thompson, J., 273
 Thompson, L., 242
 Thompson, V. A., 290
 Thomson, D. M., 218
 Thorkildsen, T. A., 397
 Thorndike, E. L., 80, 81, 82, 83, 84, 204,
 238, 239, 275
 Thorndyke, P. W., 197, 229
 Thorne, S. L., 292

 Thrash, T. M., 392, 394
 Tiedemann, J., 503
 Timperley, H., 147, 153
 Tisher, R. P., 257
 Titchener, E. B., 9
 Tolman, E. C., 143, 144, 147, 148
 Tolmie, A., 273
 Tolson, J., 34
 Tom, D. Y. H., 470, 471, 472
 Tonks, S., 375, 450, 451
 Tonks, S. M., 139, 149, 267, 375, 377,
 378, 380
 Towse, J., 177
 Trabasso, T., 226
 Tracey, T. J. G., 405
 Trautwein, U., 375, 377, 390, 406
 Trawick-Smith, J., 54, 66
 Treffinger, D. J., 291
 Treisman, A. M., 183
 Treyens, J. C., 201
 Tricot, A., 255
 Trienekens, N., 142
 Tronsky, L. N., 307
 Trotte, H., 483
 Trout, A. L., 422
 Troyer, L., 385
 Truman, J., 478
 Tsikalas, K. E., 298
 Tucker, D. M., 62
 Tudge, J. R. H., 330, 331, 333, 337, 341, 344
 Tulving, E., 179, 218, 229
 Tunmer, W. E., 389
 Tuovinen, J. E., 353
 Turner, J. A. P., 290
 Turner, J. C., 394, 404
 Turvey, M. T., 187
 Tweney, R. D., 10

 Underwood, B. J., 171, 229
 Unsworth, N., 189
 Urdan, T. C., 465
 Usher, E. L., 423, 424, 425, 428, 429, 430
 Usher, M., 190

 Vagge, S., 297
 Vainikainen, M-P., 284
 Valadez, C., 223
 Valentine, C. W., 88, 131
 Valentine, J. C., 153, 494
 van Boxtel, C., 287
 van de Pol, J., 318, 335
 van den Berg, M., 176
 van den Bergh, H., 387
 van der Helm, P. A., 173, 174
 Van der Kleij, F. M., 293, 294
 van Drie, J., 287
 Van Etten, S., 495
 van Genuchten, E., 296
 van Gog, T., 43, 48, 162, 210, 225, 236
 van Joolingen, W. R., 295

 van Laar, C., 386
 van Leeuwen, C., 173, 174
 van Merriënboer, J. J. G., 211, 236, 303
 van Putten, C. M., 307
 Vandell, D. L., 486
 Vandergrift, N., 497
 Vandewater, E. A., 490, 491
 VanEpps, E. M., 447
 VanLehn, K., 135, 256, 295
 VanLehn, K. A., 239, 247
 Vannest, K. J., 274
 Varma, S., 31, 43, 44, 62, 70
 Vauras, M., 419
 Vecchio, G. M., 429, 430
 Vecchione, M., 429, 430
 Vekiri, I., 503
 Vellutino, F. R., 51, 57
 Verdi, M. P., 205, 206
 Verhelst, N. D., 307
 Vestal, M., 8
 Vispoel, W. P., 390
 Voelkl, K. E., 477, 482
 Volet, S., 419
 Vollmeyer, R., 448
 Volman, M., 318, 335
 vom Hofe, R., 305
 von der Heydt, R., 173
 VonSecker, C., 267
 Vorgan, G., 61
 Voss, J. F., 254, 257
 Vygotsky, L., 332, 333, 337, 338, 342, 436,
 444, 473

 Waddington, D. I., 286
 Wade, A., 301
 Wade, C. A., 286, 292, 301
 Wadsworth, B. J., 319, 321, 323
 Wagemans, J., 173, 174
 Wager, W. W., 207, 210
 Wagner, A. D., 40
 Wagner, A. L., 475
 Walker, R., 154
 Wallas, G., 275
 Waller, T. G., 205, 206
 Wallet, P. A., 301
 Wallis, C., 54
 Walsh, M. M., 196
 Walters, R. H., 126, 132
 Wang, F., 406
 Wang, S-H., 32, 49
 Ward, D. S., 157
 Warschauer, M., 294
 Wartella, E. A., 490, 491
 Washington, V., 485
 Wason, P. C., 290
 Wass, S. V., 184
 Wasylikiw, L., 79
 Watson, J. B., 79, 87, 93, 131, 174
 Webb, R. B., 157, 158
 Webley, K., 116

- Weikart, D., 485
 Weimer, R., 307
 Weinberg, R. A., 485
 Weiner, B., 361, 362, 363, 366, 381, 383, 384, 385, 427
 Weinstein, C. E., 434, 435, 438, 439, 441, 453, 454
 Weinstein, R. S., 465
 Weiss, M., 156
 Weiss, M. R., 137, 138
 Wellborn, J. G., 400
 Wellman, H. M., 261, 263, 264, 341
 Welsh, J. A., 485
 Wenger, E., 463
 Wentzel, K. R., 372, 393, 469, 477, 478, 479, 482
 Wertheimer, M., 173–174, 275, 276, 277
 Wertsch, J. V., 331, 333, 445
 West, B. J., 417, 421
 Whaley, G. J. L., 487
 Wheeler, L., 387
 White, M., 407
 White, M. C., 15, 347
 White, P. H., 430
 White, R., 257
 White, R. K., 497
 White, R. T., 257
 White, R. W., 398, 402
 Whitebread, D., 264
 Wickelgren, W. A., 230
 Wiese-Bjornstal, D. M., 137
 Wigfield, A., 139, 149, 150, 267, 375, 377, 378, 380, 450, 451, 475, 477
 Wiley, J., 254, 257
 Wiliam, D., 21
 Wilkerson, S. B., 112
 Wilkins, J. L. M., 406
 Wilkinson, B., 456
 Willems, P. P., 487
 Williams, J. M., 273
 Williams, W. M., 229
 Willingham, D., 499
 Willoughby, T., 243, 255, 273, 434, 442
 Wilson, B. G., 292, 293
 Wilson, P. H., 21, 23
 Windholz, G., 85, 86
 Windschitl, M., 273, 351
 Winett, R. A., 106
 Winkler, R. C., 106
 Winne, P. H., 210, 433, 434, 442, 453
 Winsler, A., 339, 441
 Winterhoff, P. A., 330, 331
 Wirkala, C., 341
 Witkin, H. A., 500
 Wittwer, J., 302
 Wixson, K. K., 197, 201, 259
 Wolery, M., 140
 Wolfe, P., 32, 33, 34, 37, 38, 39, 42, 43, 44, 45, 47, 49, 53, 61, 65, 73, 181, 182, 184, 186, 189, 232
 Wolleat, P. L., 385
 Woloshyn, V., 243, 255, 273, 434, 442
 Wolpe, J., 88
 Wolters, C. A., 157, 392, 448, 476
 Wood, D. A., 137
 Wood, D. J., 335, 337
 Wood, E., 243, 255, 273, 434, 442
 Wood, L. A., 140, 142, 154
 Wood, R., 273, 396, 430
 Wood, R. E., 298
 Wood, W., 90
 Woodard, S. M., 269
 Woodward, J., 295
 Woodworth, R. S., 82, 362
 Woolfolk Hoy, A., 158
 Woolfolk-Hoy, A. E., 157
 Worsham, M. E., 467
 Wortham, D., 161, 162, 271, 302, 303
 Wouters, P., 297, 303
 Wozney, L., 301
 Wozniak, R. H., 406
 Wundt, W., 7–9, 449
 Wurf, E., 390
 Würtele, S. K., 156
 Wüstenberg, S., 284
 Wylie, R. C., 151, 390
 Xie, K., 298
 Xie, Q., 492, 493
 Yang, Y.-S., 298
 Yeager, D. S., 397
 Yerkes, R. M., 363
 Yough, M. S., 21
 Young, M. D., 301
 Yu, S., 18
 Yu, S. L., 448, 452
 Zeidner, M., 407, 408
 Zepeda, C. D., 263
 Zepeda, S. J., 112
 Zhang, L., 478, 499, 500, 503
 Zhang, Q., 196
 Zhang, Y., 144, 146
 Zhao, R., 298
 Zheng, B., 294
 Zigler, E. F., 494
 Zimmer, J. W., 179
 Zimmerman, B. J., 26, 114, 126, 129, 130, 131, 133, 135, 136, 147, 150, 151, 154, 246, 259, 263, 273, 298, 322, 361, 381, 385, 386, 395, 399, 400, 417, 418, 419, 423, 424, 425, 426, 428, 429, 430, 431, 432, 434, 448, 449, 450, 452, 453, 454, 455
 Zimmerman, C., 257
 Zimmerman, E., 295
 Zito, J. R., 455
 Zohar, A., 263, 264, 265
 Zumbrunn, S., 153
 Zusho, A., 392, 393, 394, 395, 423, 432, 496

- Boy Scouts of America, 494
- Brain, 31. *See also* Brain development; Neuroscience of learning
 anatomy of, 73–74
 localization and interconnections, 38–40
 myths about, 67–68, 68t
 neural organization, 33–34
 plasticity of, 49, 74
 research methods, 40–44, 42t
 research relevance, 67, 76t
 spinal cord and, 32
 structures of, 34–38, 35f, 39t
- Brain development, 52–61
 factors affecting, 52–54, 52t
 language development, 57–59
 phases of, 54
 sensitive periods for, 55–57, 56t, 68
 technology influence on, 60–61
- Brain stem, 35
- Brainstorming, 292
- Branching programs, 116, 117f
- Broca's area, 37, 38, 39t, 51
- Bruner, Jerome, 327–329
- Buggy algorithms, 306
- Can factor, 382
- Capacity beliefs, 400
- Capacity theory of language comprehension, 225
- CAT (computerized or computed axial tomography) scan, 42, 42t
- Categorical (inferential) style, 502
- Categorical clustering, 172–173
- Categorization style, 501–502
- Causal dimensions of attributions, 384–385, 384t
- Cautiousness learning style, 500
- Cell assemblies, 48
- Central executive, 190
- Central nervous system (CNS), 31, 32, 73
- Cerebellum, 35–36, 39t
- Cerebral cortex, 34, 39t
- Cerebrum, 34
- Chaining, 104–105
- Chameleon effect, 133
- Change, role in learning, 3–4
- Children and adolescents
 analogical reasoning, 282–283
 auditory development, 56
 brain development, 52–61
 electronic media influence on, 489–492
 implicit theories in, 397, 446–448
 language development, 4, 57–59
 sensory motor development, 56
 social comparison, 387–389
 teaching, strategies for, 55
 transitions in schooling, 474–476
 visual development, 56
 visual memory, 237
- Choice, in self-regulated learning, 27
- Chunking, 189
- Clarification, 287, 287t
- Class discussions, 355
- Classical conditioning, 84–89, 363
 emotional conditioning, 87–89
 informational variables, 87
 processes of, 85–87, 85t, 86f
- Classification, inductive reasoning and, 288
- Classificatory level (concept attainment sequence), 270
- Client-centered therapy, 369–371
- Climate of learning environment, 476–478, 497–499
- Closure principle in Gestalt theory, 175f, 176
- Cognition, learning theories and, 2
- Cognitive apprenticeships, 336
- Cognitive behavior modification, 107
- Cognitive conflict, 322
- Cognitive consistency theory, 364–366
- Cognitive constructivist theories, 314
- Cognitive development theory (Piaget), 319–324
 equilibration, 320
 instruction implications, 323–324, 323t
 mechanisms of learning, 322–323
 neo-Piagetian theories, 324–327
 stages of, 320–322, 321t
- Cognitive dissonance, 365–366
- Cognitive growth theory (Bruner), 327–329
- Cognitive learning processes, 252–311
 concept learning, 267–274
 creativity, 291–292
 critical thinking, 285–286
 instructional applications, 302–308
 metacognition, 258–267
 problem solving, 274–285
 reasoning, 287–290, 287t
 skill acquisition, 254–258
 technology and, 292–301
- Cognitive load, 210–212
- Cognitive maps, 148
- Cognitive modeling, 135–136
- Cognitive skill learning, 135–137
- Cognitive strategies, 207
- Cognitive tempo, 502–503
- Cognitive theories, 24. *See also* Information processing theory; Social cognitive theory
 factors affecting learning, 24–25, 165t
 implications for instruction, 27, 165t
 on memory, 25, 165t
 on motivation, 25–26, 165t
 on self-regulated learning, 26–27, 165t, 423–432
 on transfer, 26, 165t
- Collaborative learning, 211
- Collective self-efficacy, 150
- Collective teacher efficacy, 158
- Collectivism, 495–496
- The Common Core State Standards for English Language Arts and Mathematics* (National Governors Association Center for Best Practices and Council of Chief State School Officers), 15
- Common direction principle in Gestalt theory, 175f, 176
- Community influences, 492–494
- Community social capital, 493
- Comparative organizers, 206
- Competence
 of models, 139t, 140–141
 in teaching adolescents, 55
- Competitive reward structures, 411
- Complexity
 of cognitive processes, 69
 of learning theories, 69–70
- Computational problem solving, 305–307
- Computer-adaptive systems, 118
- Computer-assisted instruction (CAI), 294–295
- Computer-based instruction (CBI), 116, 294–295
- Computer-based learning environments (CBLEs), 293–299
- Computer-based learning methods, 246
- Computer-mediated communication (CMC), 301
- Computer-supported learning environments (CSLEs), 19–20
- Concept attainment, 269–270
- Concept definitions, 205–206
- Conceptions of ability, 396
- Concept learning, 267–274
 inductive reasoning and, 288
 motivational processes, 273–274
 nature of concepts, 267–269
 socially mediated learning and, 341
 teaching concepts, 270–272, 272t
- Concept maps, 246, 271
- Concept-Oriented Reading Instruction (CORI)*, 266–267
- Concepts, nature of, 267–269
- Conceptual problem solving, 305–306, 307–308
- Concrete level (concept attainment sequence), 269–270
- Concrete operational stage (cognitive development), 321–322, 321t
- Conditional knowledge, 259, 260t
- Conditional regard, 369
- Conditioned Reflexes* (Pavlov), 93
- Conditioned response (CR), 85–87
- Conditioned stimulus (CS), 85–87
- Conditioning, types of, 95

- Conditioning theories, 79, 363–364, 511.
See also Behavior theories (behaviorism)
 classical conditioning, 84–89
 contiguous conditioning, 89–93
 operant conditioning, 93–108, 130t, 131
- Conditions of learning, 207–210
- Conjunctive concepts, 268
- Connectionism, 80–84
 mental discipline, 84
 models of, 204–205
 principles of, 81–83
 sequence of curricula, 83–84
 teaching principles, 83
 trial-and-error learning, 80–81, 81f
- Consequences in behaviorism, 81
- Consistency checking, 440–441
- Consolidation, 49–50, 61, 74, 76t
- Consonant cognitions, 365
- Constructivism, 312–359, 511
 assumptions, 314–316
 cognitive development theory (Piaget), 319–324
 cognitive growth theory (Bruner), 327–329
 defined, 315
 instruction and, 319, 351–355
 learning environments, 344–351
 neo-Piagetian theories, 324–327
 peer-assisted learning, 343–344
 perspectives, 316–317, 317t
 private speech, 338–340
 self-regulated learning in, 444–448, 444t
 situated cognition, 317–319
 socially mediated learning, 341–342
 sociocultural theory (Vygotsky), 330–337
- Contemporary achievement motivation model, 375–378, 376f
- Contemporary information processing model, 180–181, 180f
- Content
 deductive reasoning and, 290
 integrating with context, 41
- Context
 defined, 463
 integrating with content, 41
 interpreting, 39
- Contextual influences, 462–507, 464f
 classroom/school climate, 476–478, 497–499
 of communities, 492–494
 of culture, 494–496
 developmentally appropriate instruction, 473–474, 474t
 of families, 483–492, 503–504
 future research, 512
 instructional applications, 496–504
 on learning environments, 465–469
 of peers, 478–483
 teacher–student interactions, 469–472, 496–499
 transitions in schooling, 474–476
 types of, 372
- Contiguous conditioning
 acts and movements in, 89–90
 habit formation and change, 90–93, 91t
- Contingency, 400
- Contingency contracts, 118–119
- Continuous schedules for reinforcement, 100
- Control (executive) processes, 177
- Control beliefs, 400
- Controllability dimension of attributions, 385
- Cooperative learning, 343–344
- Cooperative reward structures, 411
- Coordinate concepts, 271
- COPES, 434
- Coping models, 154–155
- Co-regulation, 419
- Corpus callosum, 36, 38, 39t, 52
- Correlational research, 12, 12t
- Cortisol, 65–66
- Cost belief, 377
- Counting, 306
- Covert verbalization, 338
- Creative Problem Solving (CPS) model, 278, 291–292
- Creativity (creative thinking), 291–292
- Crick, Francis, 234
- Critical thinking, 285–286
- Criticism, 498–499
- Critique of Pure Reason* (Kant), 5
- Cue-dependent forgetting, 229
- Cueing retrieval, 210, 210t
- Cultural influences, 337, 494–496
 in achievement motivation model, 378
 on emotions, 64–65
 in motivation, 361
 in self-regulated learning, 444–446
- Curricula, sequence of, 83–84
- Data mining, 19–20
- Debates, 355
- Decay, forgetting and, 230–231
- Decision making in teaching
 adolescents, 55
- Declarative knowledge, 197–199, 198f, 207, 219–221, 260t
- Declarative memory, 47
- Deductive reasoning, 289–290
- Democratic (collaborative) leadership style, 497
- Dendrites, 34
- Deprivation needs, 367
- Descartes, René, 5
- Descriptive (analytic) style, 502
- Desensitization, 88–89
- Determining tendencies, 449
- Development (theory of imitation), 130t, 131
- Developmentally appropriate instruction, 473–474, 474t
- Developmental status, 24, 139–140, 139t, 387–389
- Dewey, John, 9–10
- Dialectical constructivism, 317, 317t
- Dialogues, 15t, 18
- Dichotic listening theory, 182
- Differentiated instruction, 115–118
- Differentiated task structures, 466
- Difficulty of goals, 144t, 146–147
- Dimensionality, 465–466, 465t
- Direct observations, 15t, 16
- Discovery learning, 351–354
- Discrimination
 in classical conditioning, 85
 in operant conditioning, 102–103
- Discriminative stimulus (S^D), 96
- Discussions, 355
- Disequilibrium, 322
- Disinhibition, 132t, 133, 478–479
- Disjunctive concepts, 268
- Dissonance theory, 365–366
- Dissonant cognitions, 365
- Distance learning, 300–301
- Domain specificity, 254–255
- Dopamine, 54, 62–63
- Doubt, as method of inquiry, 5
- Drive reduction, 363
- Drives, defined, 362
- Drive theory, 362–363
- Dropout, 482–483
- Dual (two-store) memory model, 176–178
- Dual-code theory, 236
- Duration measures, 421
- Dynamic visualizations, 236
- Early education, role of, 69, 484–485
- Ebbinghaus, Hermann, 8
- Echoic memory, 186–187
- Education. *See* Instruction
- Educational data mining, 19–20
- Educational Psychology* (Thorndike), 80
- EEG (electroencephalograph), 42–43, 42t
- Effectance motivation, 321, 398
- Effective environmental force, 382
- Effective learning environments, 465–469
- Effective personal force, 382
- Efficacy expectations. *See* Self-efficacy
- Effort, ability vs., 379–381, 409–411
- Effortful control, 60
- Egocentric, 321
- Ego-involved goals, 393
- Ego involvement, 380–381
- Einstein, Albert, 234

- Elaboration
 in encoding, 191–192
 in knowledge retrieval, 219–221
 in knowledge storage, 199
 role in consolidation, 50
 in self-regulated learning, 436, 437t
- Elaboration theory, 211
- Elaborative rehearsal, 191–192
- E-learning, 298
- Electronic bulletin board
 (conference), 301
- Electronic media, 489–492
- Emergent motivation, 404
- Emotional conditioning, 87–89
- Emotional development, sensitive periods
 for, 56t
- Emotions
 motivation and, 407–408
 neuroscience of, 64–66, 75
- Empiricism, 6–7
- Enactive learning, 128–129
- Enactive representation, 327, 327t
- Encoding, 25, 188–194
 critical issues for learning, 249t
 forgetting and, 229
 influences on, 191–194
 in language utilization, 226–227
 strength of, 230
 working memory (WM), 188–191, 190f
- Encoding–retrieval similarity, 218, 244–245
- Encoding specificity hypothesis, 218–219
- Endogenous constructivism, 317, 317t
- Endogenous relationships, 296
- Endurance of learning, 4
- Entity theory, 396
- Environmental stimulation, role in brain
 development, 52t, 53
- Episodic buffer, 190
- Epistemic thinking, 263–264
- Epistemology, 5, 263, 315
- Equilibration, 320
- Error identification and correction in skill
 acquisition, 254–255
- Essay Concerning Human Understanding*
 (Locke), 6
- Essential processing, 211
- Esteem needs, 366
- Ethnic differences in attributions, 385–386
- Evaluation
 in critical thinking, 286
 in reasoning, 287t, 290
- Event-related potentials, 43, 57
- Every Student Succeeds Act of 2015, 15
- Evoked potentials, 57
- Executive (control) processes, 177,
 184, 207
- Executive function, 47, 190–191
- Exogenous constructivism, 316, 317t
- Expectancy, 377, 385
- Expectancy-value theory, 373–375
- Expectations
 in classical conditioning, 87
 goal-setting and, 386–387
 in preparation for learning, 209, 210t
 of students, 372
 of teachers, 470–472
- Experience
 as method of inquiry, 6–7
 role in learning, 4
- Experimental method, 8
- Experimental research, 12–13, 12t
- Expert problem solving
 novices vs., 284–285, 307–308
 in science, 257–258, 258f
- Expert systems, 294
- Explicit instruction, 221
- Expository organizers, 205–206
- External conditions, 208
- External locus of control, 381
- Extinction in classical conditioning, 85
- Extraneous processing, 211
- Extrinsic cognitive load, 211
- Extrinsic motivation, 398, 404
- Facilitators, teachers as, 370
- False memory, 222–223
- Family influences, 483–492, 503–504
 on achievement motivation, 379
 electronic media, 489–492
 home environment, 486
 parental involvement, 486–489
 socioeconomic status (SES), 483–486
- Far transfer, 240, 241t
- Fatigue method (contiguous
 conditioning), 91t, 92
- Feature analysis, 188
- Feature-integration theory, 183
- Features analysis theory, 268
- Feedback
 in attribution change programs, 409–411
 from teachers, 469–470, 497
- Field dependence–independence, 500–501
- Field expectancies, 147–148
- Field research, 12t, 14
- Figural transfer, 241, 241t
- Figure–ground relation principle,
 174–175, 175f
- Filter (bottleneck) theory, 182–183
- Fixed-interval (FI) schedules for
 reinforcement, 100
- Fixed mindset, 396
- Fixed-ratio (FR) schedules for
 reinforcement, 101
- Flipped classrooms, 297–298
- Flow, 404
- Forgetting, 217, 227–232
 contiguous conditioning and, 90
 information processing in, 230–232
 interference theory, 227–230, 228t
 minimizing, 231–232
- Formal level (concept attainment
 sequence), 270
- Formal operational stage (cognitive
 development), 321t, 322
- Forward-reaching transfer, 241t, 242
 4-H clubs, 494
- Freedom to Learn* (Rogers), 370
- Free-recall learning, 172–173
- Frequency counts, 421
- Frontal lobes, 37–38, 39t
- Functional analysis of behavior, 94–95
- Functional fixedness, 202, 277
- Functionalism, 9–10
- Functional magnetic resonance imaging
 (fMRI), 42t, 43–44
- Future of learning research, 511–512
- Games, 295–296
- Gedanken experiment, 234
- Gender differences
 in attributions, 385
 in brain, 68
 in self-efficacy, 152
- Generalization
 in advance organizers, 206
 of behaviors, 26
 in classical conditioning, 85, 86f
 in connectionism, 82
 in operant conditioning, 102, 102t,
 103, 239
 in transfer of learning, 210, 210t
- Generalized reinforcers, 98
- General Problem Solver (GPS), 280
- General skills, 254–255, 256
- General strategies for problem
 solving, 279
- Generate-and-test strategy, 280
- Generative processing, 211
- Genetics, role in brain development,
 52t, 53
- Germane cognitive load, 211
- Gestalt theory, 173–176, 275, 277
- Girl Scouts of America, 494
- Gist representations, 225–226
- Given-new contract, 227
- Glial cells, 33–34, 68, 73
- Global functioning, 500–501
- Global-specific attributions, 401
- Goal orientations, 392–397, 411–412
 conceptions of ability, 396
 cultural influences on, 495
 implicit theories, 396–397
 types of, 392–396
- Goal progress feedback, 147
- Goals
 in achievement motivation model,
 377–378
 effect on modeling, 139t
 expectations and, 386–387
 as motivational process, 143–147

- in self-evaluation, 429–431
 - in self-judgment, 426–427
 - setting, 441
- Goal-setting theory, 392
- Goal theory, 392
- Graphics, 72, 73
- Growth mindset, 393, 396
- The Growth of the Mind* (Koffka), 173
- Guthrie, Edwin R., 89–93

- Habit formation and change, 90–93, 91t
- Hall, G. Stanley, 7
- Head Start, 484–485
- Health, self-efficacy and, 159–160
- Hebb's theory, 48
- Hedonism, 362
- Helplessness, learned, 400–402
- Help seeking, 451–452
- Heuristics, 277–278
- Hierarchical organization
 - of concepts, 271
 - in encoding, 192–193, 192f
 - of learning, 209f
 - Maslow's hierarchy of needs, 366–369, 367f
 - in propositional networks, 196–197
- Higher mental function, 444
- Higher-order conditioning, 86
- Highlighting, 436
- High-road transfer, 241–242, 241t
- High/Scope Perry Preschool Project, 485
- Hill climbing, 281–282
- Hippocampus, 36, 39t
- Hippocrates, 38
- History of learning theories, 4–10
- Holistic, defined, 366
- Holistic teaching, 345
- Home environment, 486
- Homeostasis, 362
- Homeostatic, 364
- Homework, 247
- Humanistic theories, 366–371
- Hume, David, 6
- Hypothalamus, 36, 39t
- Hypotheses, 11

- Iconic memory, 186–187
- Iconic representation, 327, 327t
- IDEAL heuristic, 278
- Identical elements, 82, 238
- Identity level (concept attainment sequence), 270
- If-then statements, 201
- Illumination stage (problem solving) 275
- Imaginal system (in LTM), 236
- Imitation, theories of, 130–132, 130t
- Implicit theories, 261, 341, 396–397, 446–448

- Importance
 - attention and, 184–186
 - role in arousing attention, 45–46
- Inaccessibility of information, 229
- Incompatible response method
 - (contiguous conditioning), 91t, 92–93
- Incongruity, 399–400
- Incremental theory, 396
- Incubation stage (problem solving), 275
- Individual constructivist theories. *See* Cognitive constructivist theories
- Individualism, 495–496
- Individualistic reward structures, 411
- Inductive reasoning, 287–289, 351–352
- Inference
 - in critical thinking, 286
 - in reasoning, 287–290, 287t
- Information processing system, 44–48
- Information processing theory, 168–251, 511. *See also* Cognitive theories
 - assumptions, 170
 - attention, 182–186
 - contemporary model, 180–181, 180f
 - encoding, 188–194
 - forgetting, 227–232
 - Gestalt theory, 173–176
 - instructional applications, 205–212, 244–247
 - language comprehension, 223–227
 - levels (depth) of processing theory, 178–180
 - long-term memory (LTM) retrieval, 218–227
 - long-term memory (LTM) storage, 195–205
 - perception, 186–188
 - relearning, 232–233
 - self-regulated learning in, 432–444
 - transfer, 237–244
 - two-store (dual) memory model, 176–178
 - verbal learning, 170–173
 - visual memory, 233–237
- Inhibition, 132t, 133, 478–479
- Inquiry teaching, 354–355
- Insightful learning, 174
- Insight in problem solving, 275–277
- Instincts, 130–131, 130t, 362
- Instruction
 - of adolescents, strategies for, 55
 - behavior theories and, 27, 108–119, 121t
 - brain research and, 67–73, 76t
 - cognitive development theory (Piaget) and, 323–324, 323t
 - cognitive learning processes and, 302–308
 - cognitive theories and, 27, 160–163, 165t
 - of concepts, 270–272, 272t
 - constructivism and, 319, 344–355, 357t
 - contextual influences and, 496–504
 - emotions in, 66
 - information processing theory and, 205–212, 244–247, 249t
 - interference theory in, 229
 - language development and, 58–59
 - learning and, 21–23, 510
 - in learning strategies, 442–444, 443t, 453
 - mental discipline, 84
 - motivation and, 408–412
 - Rogers' client-centered therapy and, 370–371
 - self-regulated learning and, 452–458
 - sequence of curricula, 83–84
 - sociocultural theory (Vygotsky) and, 334–337
 - Thorndike's principles of teaching, 83
- Instructional methods, 111
- Instructional scaffolding. *See* Scaffolding
- Instructional variables, 372
- Instrumental behavior, 130t, 131–132
- Intellectual skills, 207
- Intensity, role in arousing attention, 46
- Interconnections in brain, 38–40
- Interest, 406–407
- Interest value, 377
- Interference theory, 227–230, 228t
- Interleaving, 65, 303
- Intermittent schedules for reinforcement, 100
- Internal causes, 382
- Internal conditions, 208
- Internal–external attributions, 401
- Internalization, 154, 432, 445–446
- Internal locus of control, 381
- Internet-based instruction, 298
- Interval schedules for reinforcement, 100–101
- Interviews, 15t, 18
- Intrinsic cognitive load, 211
- Intrinsic motivation, 398–406
 - historical views on, 398–400
 - perceived control, 400–402
 - rewards and, 403–405
 - self-determination, 402–403
- Intrinsic value, 377
- Introspection, 9
- Involvement, 400, 482
- Irrelevant cognitions, 365
- Irreversibility, 321

- James, William, 7, 10
- Jigsaw method, 344

- Kant, Immanuel, 5–6
- Kekulé, August, 234
- Keyword method, 438

- Knowledge
 in constructivism, 315
 in critical thinking, 286
 empiricist doctrine of, 6–7
 forgetting, 227–232
 rationalist doctrine of, 5–6
 relearning, 232–233
 retrieval of, 218–223
 storage of, 197–201, 198f
 transfer of, 237–244
 types of, 260t
- Knowledge maps. *See* Concept maps
- Knowledge representation, 327–328, 327t, 329
- Laboratory research, 12t, 14
- Laissez-faire style, 497
- Language comprehension
 parsing, 223–226
 utilization, 226–227
- Language development, 4
 brain structures and, 37–38, 51–52
 sensitive periods for, 56t, 57–59
- Lateralization in brain, 40
- Law of Disuse, 81
- Law of Effect, 81, 83
- Law of Exercise, 81, 82
- Law of Readiness, 81–82
- Law of Use, 81
- Learned helplessness, 400–402
- Learned optimism, 402
- Learner-centered principles, 347, 348t, 349
- Learner choice, 423–424, 424t
- Learner variables (metacognition), 261
- Learning. *See also* Cognitive learning processes; Observational learning
 assessment of, 14–21, 15t
 attention and, 183–184
 conditions of, 207–210
 in constructivism, 357t
 contextual influences on, 462–507
 criteria of, 3–4, 4t
 defined, 3–4
 enactive vs. vicarious, 128–129
 encoding, 249t
 future research, 511–512
 hierarchy of, 209f
 instruction and, 21–23, 510
 interference theory in, 229
 metacognition and, 260–261
 model of motivated learning, 371–372, 371t
 neuroscience of, 30–77 (*See also* Neuroscience of learning)
 occurrence of, 24–25, 509
 in operant conditioning, 95
 peer influences on, 478–480
 performance vs., 129
 phases of, 208–210, 208t, 210t
 preparation for, 209
- problem solving and, 283–284, 303–305
 retrieval-based, 245–246
 self-concept and, 390–391
 three-term contingency, 121t
 understanding in, 275–276
- Learning analytics, 19–20
- Learning and Study Strategies Inventory (LASSI), 454
- Learning curves, 172f
- Learning difficulties, correcting, 69
- Learning environments, 465–469
 adjustment to, 481–483
 climate of, 476–478, 497–499
 management, 466–467
 organization, 465–466
 TARGET variables, 467–469, 467t
 transitions in, 474–476
- Learning environments in constructivism, 344–351
 APA learner-centered principles, 347, 348t, 349
 principles of, 345–347, 345t
 reflective teaching, 347–351, 350t
- Learning goals, 392–396, 393f
- Learning hierarchies, 208
- Learning management systems (LMSs), 19–20
- Learning outcomes, 207, 207t
- Learning strategies in self-regulated learning, 431–432, 434–444, 437t
 affective methods, 441–442
 effectiveness of instruction, 442–444, 443t, 453
 elaboration, 436–439
 monitoring, 440–441
 organization, 439–440
 rehearsal, 436
- Learning styles, 499–503
- Learning theories, 2–3, 510–511
 behavior theories, 24, 78–123 (*See also* Behavior theories (behaviorism))
 cognition and, 2
 cognitive theories, 24, 124–167 (*See also* Cognitive theories)
 complexity of, 69–70
 constructivism, 312–359 (*See also* Constructivism)
 critical issues for, 23–27, 23t, 76t, 121t, 249t, 357t, 509–510
 functionalism, 9–10
 history of, 4–10
 philosophy and, 5–7
 psychological research of, 7–10
 research and, 11–14
 structuralism, 9
- Learning time, 111–113
- Leveling learning style, 500
- Levels (depth) of processing theory, 178–180
- Linear programs, 116
- Listening, 227
- Literal transfer, 241, 241t
- Little Albert experiment, 87–88
- Localization in brain, 38–40
- Locke, John, 6
- Locus dimension of attributions, 385
- Locus of control, 381–382
- Long-term memory (LTM), 44, 47, 195–205
 connectionist models, 204–205
 in contemporary information processing model, 180–181
 critical issues for learning, 249t
 knowledge storage, 197–201, 198f
 language comprehension, 223–227
 perception vs., 187–188
 production systems, 201–204
 propositions, 195–197
 relearning and, 232
 retrieval processes, 218–223
 technology influence on, 60–61
 in two-store (dual) memory model, 177
 visual memory and, 236–237
- Low-road transfer, 241–242, 241t
- Luria, Alexander, 330, 338
- Magnetic resonance imaging (MRI), 42t, 43–44
- Maintenance rehearsal, 191–192
- Management of learning environments, 466–467
- Mapping, 439–440, 440f
- Maslow, Abraham, 366–369
- Maslow's hierarchy of needs, 366–369, 367f
- Mastery goals, 393
- Mastery learning, 113–115
- Mastery models, 154–155
- Mastery motivation, 321, 398–399
- Matched-dependent behavior, 131–132
- Mathematics
 cognitive learning processes in, 305–308
 sociocultural theory (Vygotsky) and, 336–337
- Meaningfulness
 attention and, 184–186
 in knowledge retrieval, 219
 in knowledge storage, 198–199
 in learning, 191
- Meaningful reception learning, 205, 230
- Means–ends analysis, 280–282, 281f
- Mediation, 332
- Memory. *See also* Long-term memory (LTM); Sensory registers; Short-term memory (STM); Working memory (WM)
 in behavior theories, 121t
 in cognitive theories, 165t

- in constructivism, 357t
- contemporary information processing model, 180–181, 180f
- contiguous conditioning and, 90
- false memory, 222–223
- forgetting, 227–232
- in information processing theory, 249t
- levels (depth) of processing theory, 178–180
- metacognition and, 261
- neuroscience of, 76t
- relearning and, 232
- research on, 8
- role in learning, 25, 509
- two-store (dual) memory model, 176–178
- visual memory, 233–237
- Memory* (Ebbinghaus), 8
- Memory networks, 48–50
- Memory scanning, 189–190
- Meno* (Plato), 5
- Mental discipline, 84, 238–239
- Mental imagery, 193. *See also* Visual memory
- The Mentality of Apes* (Köhler), 173
- Mentoring, 162–163
- Metacognition, 37, 258–267
 - behavior and, 264
 - conditional knowledge, 259
 - in critical thinking, 286
 - epistemic thinking and, 263–264
 - learning and, 260–261
 - reading and, 265–267
 - reasoning and, 290
 - self-regulated learning and, 433
 - variables influencing, 261–263
- Method of loci, 234, 438
- Methodology of learning research, 512
- Mill, John Stuart, 6
- Mimesis, 130
- Mind-matter dualism, 5–6
- Min model, 306
- Mixed-methods research, 13
- Mnemonics, 192, 193, 436–439
- Modeling, 130–139
 - cognitive skill learning, 135–137
 - functions of, 132–135, 132t
 - inhibition/disinhibition, 132t, 133
 - motor skill learning, 137–139
 - observational learning, 133–135, 134t
 - peer influences and, 478–480
 - response facilitation, 132–133, 132t
 - theories of imitation, 130–132, 130t
- Model of motivated learning, 371–372, 371t
- Models
 - prestige and competence of, 139t, 140–141
 - of research, 12–14, 12t
- self-efficacy and, 154–156, 160–161
- in teaching adolescents, 55
- vicarious consequences to, 139t, 141–143
- Molar behavior, 143
- Monitoring. *See* Self-monitoring (self-observation)
- Moods, 407
- Moral Disengagement: How People Do Harm and Live With Themselves* (Bandura), 126
- Motivation, 360–415
 - achievement motivation, 373–381, 408–409
 - assumptions, 362–372
 - attributions in, 381–386, 409–411
 - in behavior theories, 121t
 - in cognitive theories, 165t
 - in constructivism, 357t
 - creativity and, 291
 - in critical thinking, 286
 - cultural variables in, 361
 - defined, 361
 - in drive theory, 363
 - emotions and, 407–408
 - future research, 512
 - goal orientations, 392–397, 393f, 411–412
 - historical views on, 362–366
 - in humanistic theories, 366–371
 - in information processing theory, 249t
 - instructional applications, 408–412
 - interest and, 406–407
 - intrinsic, 398–406
 - model of motivated learning, 371–372, 371t
 - neuroscience of, 62–63, 74–75, 76t
 - in observational learning, 134–135, 134t
 - in reading comprehension, 267
 - rewards, 62–63
 - role in learning, 25–26, 509–510
 - self-regulated learning and, 448–452
 - in social cognitive theory, 143–150, 386–392
 - from vicarious consequences, 143
- Motivational processes in concept learning, 273–274
- Motivational states, 63
- Motor skill learning, 137–139, 156–157, 207
- Movements
 - in contiguous conditioning, 89–90
 - role in arousing attention, 46
- Multidimensional classrooms, 465–466, 465t
- Multilingualism, 52
- Multimedia, 296–298
- Multistage sequence (in concept learning), 269–270
- Multitasking, 60
- Myelin sheath, 34
- Myers-Briggs Type Indicator, 500
- Naïve analysis of action, 382–383
- Narrations, 421
- Narrative stories, 437
- National Head Start/Public School Early Childhood Transition Demonstration Project, 485
- Near transfer, 240, 241t
- Negative (non-) instances, 268
- Negative reinforcement, 96–97, 96t
- Negative transfer, 238
- Neo-Piagetian theories, 324–327
- Network theory, 64
- Neural (synaptic) connections, 49–50
- Neural assemblies, 51
- Neural organization, 33–34
- Neurons, 33, 33f, 68, 73
- Neuroscience of learning, 30–77
 - brain development, 52–61
 - brain research methods, 40–44, 42t
 - brain structures, 34–38, 35f, 39t
 - defined, 31
 - emotions, 64–66, 75
 - future research, 512
 - information processing system and, 44–48
 - instructional applications, 67–73
 - language development, 51–52
 - localization and interconnections in brain, 38–40
 - memory networks, 48–50
 - motivation, 62–63, 74–75
 - neural organization, 33–34
- Neurotransmitters, 34
- NIR-OT (near infrared optical topography), 42t, 44
- No Child Left Behind (NCLB) Act of 2001, 14–15, 112
- Nonsense syllables, 8
- Note taking, 438–439
- Novelty, role in arousing attention, 46
- Novice problem solving
 - experts vs., 284–285, 307–308
 - in science, 257–258, 258f
- Novice-to-expert methodology, 255–256
- Nutrition, role in brain development, 52t, 53
- Observational learning, 133–135, 134t
 - factors affecting, 139–143, 139t
 - from peers, 478–479
- Occipital lobes, 36–37, 39t
- Online instruction, 298
- Online social media, 299–300
- Operant behavior, 95

- Operant conditioning, 79, 93–108, 363–364
 behavior change in, 103–107
 current perspective on, 107–108
 discrimination in, 102–103
 as functional analysis of behavior, 94–95
 generalization in, 102, 102t, 103, 239
 Premack Principle, 98–99
 primary and secondary reinforcers, 98
 processes of, 95–103
 punishment in, 96t, 99–100
 reinforcement in, 95–98, 96t
 schedules for reinforcement, 100–101, 101f
 scientific assumptions, 94
 as theory of imitation, 130t, 131
- Operational definitions, 11
- Oral responses, 15t, 17
- Organization
 in encoding, 192–193, 192f
 Gestalt theory principles of, 174–176, 175f
 in knowledge retrieval, 221
 in knowledge storage, 199
 in learning environments, 465–466
 role in consolidation, 50
 in self-regulated learning, 437t, 439–440
- Outcome expectations
 effect on modeling, 139t
 locus of control and, 382
 as motivational process, 147–149, 149f
 self-efficacy and, 150–151, 382
- Outlining, 439
- Out-of-school programs, 112
- Overjustification hypothesis, 405
- Overt verbalization, 338
- Paired-associate learning, 172
- Paradigms of research, 12–14, 12t
- Parallel distributed processing (PDP), 204
- Paraphrasing, 440–441
- Parental involvement, 486–489, 503–504
- Parietal lobes, 37, 39t
- Parsing in language comprehension, 223, 223–226
- Pasteur, Louis, 352
- Pattern recognition, 45, 176–177, 186–188
- Pavlov, Ivan, 79, 84–89, 338. *See also* Classical conditioning
- Peer-assisted learning, 343–344
- Peer influences, 478–483
 collaboration, 335–336
 on learning, 478–480
 modeling, 154–156, 161
 networks, 480–481
 on school adjustment, 481–483
 tutoring, 343
- Pegword method, 437–438
- Perceived control, 400–402
- Perceived importance. *See* Importance
- Perceived self-efficacy. *See* Self-efficacy
- Perception, 36, 45, 186–188
 in achievement motivation model, 378
 in Gestalt theory, 174
 in language comprehension, 223
 long-term memory (LTM) vs., 187–188
 sensory registers, 186–187
 in two-store (dual) memory model, 176–177
- Performance
 factors affecting, 139–143, 139t
 goals, 143–147, 392–396, 393f
 learning vs., 129
 in preparation for learning, 209
 self-efficacy and, 152
- Permissive style, 488
- Personal agency. *See* Agency
- Personal force, 382
- Personal interest, 406–407
- Personalization, 116, 118
- Personal knowledge, 350
- Personal variables, 372
- PET (positron emission tomography) scan, 42t, 43
- Phase sequences, 48
- Phases of learning, 208–210, 208t, 210t
- Philosophy, learning theories and, 5–7
- Phi phenomenon, 173–174
- Phonemes, 58
- Physiological needs, 366
- Piaget, Jean, 319–324
- Planning in reflective teaching, 351
- Plasticity of brain, 49, 74
- Plato, 5, 234
- Positive behavior supports, 106–107
- Positive climate, 72, 73
- Positive instances, 268
- Positive regard, 369
- Positive reinforcement, 96–97, 96t
- Positive self-regard, 369
- Positive transfer, 238
- Postdecisional processing, 449
- Pragnanz*, 176
- Praise
 effect of, 498–499
 as positive reinforcement, 97
- Predecisional processing, 449
- Prefrontal cortex, 38
- Premack Principle, 98–99
- Preoperational stage (cognitive development), 321, 321t
- Preparation
 for learning, 209
 in problem solving, 275
- Prestige of models, 139t, 140–141
- Primacy effects, 173, 177
- Primary emotions, 64–65
- Primary motor cortex, 38
- Primary reinforcers, 98
- Primary signals in classical conditioning, 86
- Primary strategies, 453
- Principles of Behavior Modification* (Bandura), 126
- Principles of organization in Gestalt theory, 174–176, 175f
- Principles of Physiological Psychology* (Wundt), 8
- The Principles of Psychology* (James), 10
- Private events in operant conditioning, 94
- Private speech, 338–340
- Proactive interference, 228, 228t
- Problem-based learning (PBL), 70–72, 305
- Problems, defined, 274
- Problem solving, 274–285
 defined, 274
 in discovery learning, 352
 experts vs. novices, 257–258, 258f, 284–285, 307–308
 heuristics, 277–278
 historical views on, 275–277
 learning and, 283–284, 303–305
 in mathematics, 305–308
 in skill acquisition, 255
 strategies for, 278–283
- Problem-solving production system, 433
- Procedural knowledge, 201, 207, 221–222, 260t
- Procedural memory, 47–48
- Process goals, 394
- Process-product research, 22
- Product goals, 394
- Production in observational learning, 134, 134t
- Production systems, 194, 201–204, 239–240, 283–284, 433
- Productive thinking, 275
- Professional knowledge, 350–351
- Programmed instruction (PI), 115–116
- Project Head Start, 484–485
- Propositional content, 226
- Propositional networks, 196–197, 196f, 219–220
- Propositions, 195–197, 218, 225
- Prototypes, 268
- Prototype theory, 187–188, 268
- Proximity
 Gestalt theory principle of, 175f, 176
 of goals, 144t, 146
 in self-monitoring, 421
- Psychological differentiation, 500–501
- Psychological laboratories, 7–8
- Psychological research of learning, 7–10
- Punishment
 alternatives to, 100, 100t
 in behavior modification, 106
 in breaking habits, 93
 in connectionism, 83
 in operant conditioning, 96t, 99–100
- Purposive behaviorism, 143

- Qualitative research, 12t, 13–14
- Quality of instruction, 111
- Questioning, 438
- Questionnaires, 15t, 17–18
- Ratings by others, 15t, 17
- Rationalism, 5–6
- Ratio schedules for reinforcement, 101
- Reading
 - brain structures and, 51–52
 - metacognition and, 265–267
- Reason, as method of inquiry, 5–6
- Reasoning, 287–290, 287t
- Recency effects, 173, 177
- Reciprocal interactions, 127–128
- Reciprocal teaching, 161, 246, 265–266, 335, 436
- Reflective teaching, 347–351, 350t
- Regularity in self-monitoring, 421
- Rehearsal
 - in retention, 134
 - role in consolidation, 50
 - in self-regulated learning, 436, 437t
- Reinforcement
 - in behavior modification, 106
 - in operant conditioning, 95–98, 96t
 - in preparation for learning, 209, 210t
 - schedules for, 100–101, 101f
- Reinforcement history, 24
- Reinforcing stimulus (S^R), 96
- Relational (contextual) style, 502
- Relational concepts, 268
- Relational trust, 477
- Relation–argument link, 196
- Relearning, 232–233
- Reliability of assessments, 20
- Representation of visual information, 234–236
- Rereading, 440–441
- Research
 - on brain, 40–44, 42t, 67, 76t
 - future of, 511–512
 - learning theories and, 11–14
 - types of, 12–14, 12t
- Respondent behavior, 95
- Response facilitation, 132–133, 132t, 478–479
- Restructuring, 203
- Retention
 - of knowledge, 231–232
 - in observational learning, 134, 134t
- Reticular formation, 35, 39t
- Retrieval and responding phase of learning, 209, 210t
- Retrieval-based learning, 245–246
- Retrieval-induced forgetting, 230
- Retrieval of information
 - declarative knowledge, 219–221
 - procedural knowledge, 221–222
 - processes of, 218–223
- Retroactive interference, 228, 228t
- Rewards
 - intrinsic motivation and, 403–405
 - motivation and, 62–63
 - in self-regulated learning, 428
- Risk taking learning style, 500
- Rogers, Carl, 369–371
- Role-playing, 71, 72
- Rules
 - for concepts, 268
 - in problem solving, 276
- Rural schools, 493
- Safety needs, 366, 477–478
- Savings score, 8
- Scaffolding, 211, 335, 337
- Schedules for reinforcement, 100–101, 101f
- Schemas, 268
 - in encoding, 193–194
 - in knowledge storage, 200–201
 - in language comprehension, 226
- Schemes, 131
- School Development Program (SDP), 488–489, 489t, 493
- Science problem-solving skills, 257–258, 258f
- Secondary reinforcers, 98, 363
- Second signal system in classical conditioning, 86
- Selective perception, 209, 210t
- Self-actualization, 367–369
- Self-concept, 151, 389–391
- Self-confidence, 389
- Self-determination, 402–403, 477
- Self-efficacy, 11–12
 - achievement and, 152–154
 - agency and, 129
 - effect on modeling, 139t
 - health/therapeutic activities and, 159–160
 - models and, 154–156, 160–161, 479
 - in motor skill learning, 156–157
 - neuroscience of, 62
 - outcome expectations and, 148–149, 150–151, 382
 - performance and, 152
 - reciprocal interactions and, 127–128
 - in retrieval-based learning, 246
 - of teachers, 157–158, 159
- Self-Efficacy: The Exercise of Control* (Bandura), 126
- Self-esteem, 389
- Self-evaluation, 429–431
- Self-evaluative standards, 425–426
- Self-experience, 369
- Self-explanations, 303
- Self-fulfilling prophecies, 471
- Self-instruction, 422–423
- Self-instructional training, 107, 136–137, 339, 441
- Self-judgment, 425–428
- Self-modeling, 142–143
- Self-monitoring (self-observation), 419–422, 425, 437t, 440–441
- Self-questioning, 440–441
- Self-reactions, 428
- Self-regulated learning, 26–27, 129–130, 416–461, 510
 - assumptions, 418–419
 - in behavior theories, 121t, 419–423
 - in cognitive theories, 165t, 423–432
 - conditional knowledge and, 259
 - in constructivism, 357t, 444–448, 444t
 - cyclical nature of, 428–432, 429f
 - future research, 512
 - goal orientations, 395
 - in information processing theory, 249t, 432–444
 - instructional applications, 452–458
 - learner choice, 423–424, 424t
 - learning strategies in, 431–432, 434–444, 437t
 - models of, 433–434
 - motivation and, 448–452
 - neuroscience of, 76t
 - parental involvement, 487
 - processes of, 425–428, 425t
 - social-self interaction, 432, 432t
 - in sociocultural theory, 334
- Self-Regulated Strategy Development model, 266, 455–456
- Self-reinforcement, 423
- Self-reports, 15t, 17–18
- Self-schemas, 377–378, 451
- Self-set goals, 147
- Self-verbalization, 340, 441
- Self-worth theory, 379–380
- Semantic encoding, 209, 210t
- Sense making, 240
- Sense of community, 476–477
- Sensitive periods for brain development, 55–57, 56t, 68
- Sensorimotor stage (cognitive development), 321, 321t
- Sensory modality preference, 500
- Sensory motor development, sensitive periods for, 56, 56t
- Sensory registers, 44–45, 47, 176, 186–187
- Sentence mnemonics, 437
- Sequence of curricula, 83–84
- Serial learning, 171–172
- Serial position curve, 171, 171f
- Sesame Street*, 490
- Sets (of concepts), 271
- Seven Habits of Highly Effective People* (Covey), 227
- Shaping, 104
- Sharpening learning style, 500

- Short-term memory (STM)
 in contemporary information processing model, 180–181
 in two-store (dual) memory model, 177
- Similarity
 encoding-retrieval similarity, 218, 244–245
 Gestalt theory principle of, 175f, 176
 in modeling, 142–143, 152
- Simonides, 234
- Simple-to-complex sequencing, 211
- Simplicity principle in Gestalt theory, 175f, 176
- Simulations, 71, 72, 295
- Situated cognition, 317–319
- Situational interest, 406–407
- Skill acquisition, 254–258
 expert vs. novice problem solving, 257–258, 258f
 general and vicarious skills, 254–255, 256
 novice-to-expert methodology, 255–256
- Skinner, B. F., 79, 93–108. *See also*
 Operant conditioning
- Sleep, learning and, 68
- Small-group learning, 247
- SMART, 434
- Social cognitive theory, 124–167, 511. *See also* Modeling: Self-efficacy
 conceptual framework, 126–130
 enactive and vicarious learning in, 128–129
 instructional applications, 160–163
 learning and performance in, 129, 139–143, 139t
 motivational processes, 143–150, 386–392
 reciprocal interactions, 127–128
 self-regulated learning, 129–130, 423–432
- Social comparison, 387–389
- Social constructivist theories, 314
- Social Foundations of Thought and Action: A Social Cognitive Theory* (Bandura), 126
- Social interaction, 324
- Social Learning and Imitation* (Miller and Dollard), 126
- Social Learning and Personality Development* (Bandura and Walters), 126
- Social Learning Theory* (Bandura), 126
- Socially mediated learning, 341–342
- Socially shared regulation, 419
- Social media, 299–300
- Social-self interaction, 432, 432t
- Social support for students, 372
- Sociocultural theory (Vygotsky), 330–337
 instructional applications, 334–337
 principles of, 331–332, 332t
 self-regulated learning and, 444–446
 zone of proximal development (ZPD), 332–334
- Socioeconomic status (SES), 483–486
- Specificity
 domain specificity, 254–255
 of goals, 144t, 145–146
- Specific skills, 254–255, 256
- Specific strategies for problem solving, 279
- Speech acts, 226
- Speech-language pathologists, 227
- Spinal cord, 32
- Spiral curriculum, 328–329
- Spontaneous recovery in classical conditioning, 85
- Spreading activation, 199–200, 218
- SQ4R method, 277, 443
- Stability dimension of attributions, 385
- Stable–unstable attributions, 401
- STAD (student-teams-achievement divisions), 344
- States, motivational, 63
- Steroids, role in brain development, 52t, 53
- Stimulated recalls, 15t, 18
- Stimulus–response (S–R) associations, 170–171, 203–205
- Storage (in LTM)
 connectionist models, 204–205
 of knowledge, 197–201, 198f
 production systems, 201–204
 propositions, 195–197
- Strategy beliefs, 400
- Strategy instruction, 442–444, 443t, 453
- Strategy transfer, 243–244
- Strategy variables (metacognition), 262–263
- Structuralism, 9
- Structural stage development model (Case), 325–326
- Study improvement, 452–454
- Subject–predicate link, 196
- Subordinate concepts, 271
- Suburban schools, 492–493
- Successive approximations, 104
- Summarizing, 436
- Sum model, 306
- Superordinate concepts, 271
- Support strategies, 453
- Syllogisms, 289–290
- Symbolic representation, 327t, 328
- Synapses, 34, 54
- Synaptic gap, 34
- Systematic desensitization, 88–89
- Target skills, 208
- TARGET variables, 467–469, 467t
- Task-focused goals, 393
- Task-involved goals, 393
- Task involvement, 380–381
- Task variables (metacognition), 261–262
- Teacher expectations, 470–472
- Teacher feedback, 469–470, 497
- Teacher modeling, 136
- Teacher self-efficacy, 157–158, 159
- Teacher–student interactions, 469–472, 496–499
- Teacher support, 470
- Teaching. *See* Instruction
- Technology
 brain development and, 60–61
 cognitive learning processes and, 292–301
 computer-based learning environments (CBLEs), 293–299
 defined, 292
 distance learning, 300–301
 electronic media, 489–492
 future research, 512
 learning time and, 113
 online social media, 299–300
 role in learning, 293t
 self-regulated learning and, 457–458
The Technology of Teaching (Skinner), 93
- Teenagers. *See* Children and adolescents
- Television viewing, 490
- Template matching, 187
- Temporal lobes, 37, 39t
- Teratogens, role in brain development, 52t, 53–54
- Test anxiety, 407–408, 442
- Testing. *See* Assessment of learning
- Testing effect, 233, 269
- Test-Operate-Test-Exit (TOTE) model, 433
- Thalamus, 36, 39t
- Thematic content, 226
- Theories
 defined, 315
 functions of, 11
- Therapeutic activities, self-efficacy and, 159–160
- Think-alouds, 15t, 18
- Thorndike, Edward L., 9, 80–84. *See also* Connectionism
- Thorndike Award, 80
- Three-term contingency, 96–98, 131
- Three-term series, 289
- Threshold method (contiguous conditioning), 91t, 92
- Time management, 453–454
- Time needed/allowed for learning, 111–113
- Time-sampling measures, 421
- Titchener, Edward B., 9
- Top-down processing, 187
- Trace decay, 187
- Transfer, 237–244
 in behavior theories, 121t
 in cognitive theories, 165t

- in connectionism, 82
- in constructivism, 357t
- contemporary views on, 239–240
- encoding-retrieval similarity and, 245
- historical views on, 238–239
- in information processing theory, 249t
- neuroscience of, 76t
- role in learning, 26, 210, 510
- strategy transfer, 243–244
- teaching for, 246–247
- types of, 238, 240–243, 241t
- Transitions in schooling, 474–476
- Triadic reciprocity, 127–128, 127f
- Trial-and-error learning, 80–81, 81f, 275
- Try factor, 382
- Tuning, 203
- Tutoring, 162–163
- 21st Century Community Learning Centers, 494
- Two-store (dual) memory model, 176–178
- Type R conditioning, 95
- Type S conditioning, 95

- Unconditional positive regard, 369
- Unconditioned response (UCR), 85
- Unconditioned stimulus (UCS), 85–87
- Underlining, 436
- Understanding, 275–276
- Undifferentiated task structures, 465–466
- Unidimensional classrooms, 465–466, 465t
- Unitary theory, 236–237
- Unlearning, contiguous conditioning and, 90
- Urban schools, 492–493
- Utility value, 377

- Utilization deficiency, 263
- Utilization in language comprehension, 223, 226–227

- Validity of assessments, 20
- Value-added assessment models, 20–21
- Values, 149–150
 - in achievement motivation model, 377
 - effect on modeling, 139t
 - in self-regulated learning, 450–451
 - of students, 372
- Variable-interval (VI) schedules for reinforcement, 101
- Variable-ratio (VR) schedules for reinforcement, 101
- Verbal information, 207
- Verbalization, achievement and, 339–340
- Verbal learning, 170–173
- Verbal system (in LTM), 236
- Verification stage (problem solving), 275
- Vicarious consequences to models, 139t, 141–143
- Vicarious learning, 128–129
- Video deficit, 491
- Visual cortex, 36–37
- Visual development, sensitive periods for, 56, 56t
- Visual imagery. *See* Visual memory
- Visualizations, 236
- Visual learning style, 233–234
- Visual memory, 233–237
 - cognitive development and, 237
 - long-term memory (LTM) and, 236–237
 - representation of visual information, 234–236

- Volition, 448–450
- Volitional style, 450
- Voluntary acts, 108
- Vygotsky, Lev Semenovich, 330–337, 338

- Walden Two* (Skinner), 93
- Watson, James, 234
- Watson, John B., 79
- Web-based instruction, 298
- Wernicke's area, 37, 38, 39t, 51
- Wertheimer, Max, 173
- Worked-example effect, 162
- Worked examples, 161–162, 302–303, 303t
- Working backward, 280–281
- Working forward, 281–282
- Working memory (WM), 44–45, 47, 188–191, 190f
 - activation levels vs., 200
 - in contemporary information processing model, 180–181
 - size limitations, 202
 - technology influence on, 60–61
- Working self-concepts, 390, 451
- Writing proficiency, 454–456
- Written responses, 15t, 16–17
- Wundt, Wilhelm, 7–8

- X-rays, 42, 42t

- YMCA/YWCA, 494

- Zero transfer, 238
- Zone of proximal development (ZPD), 332–334