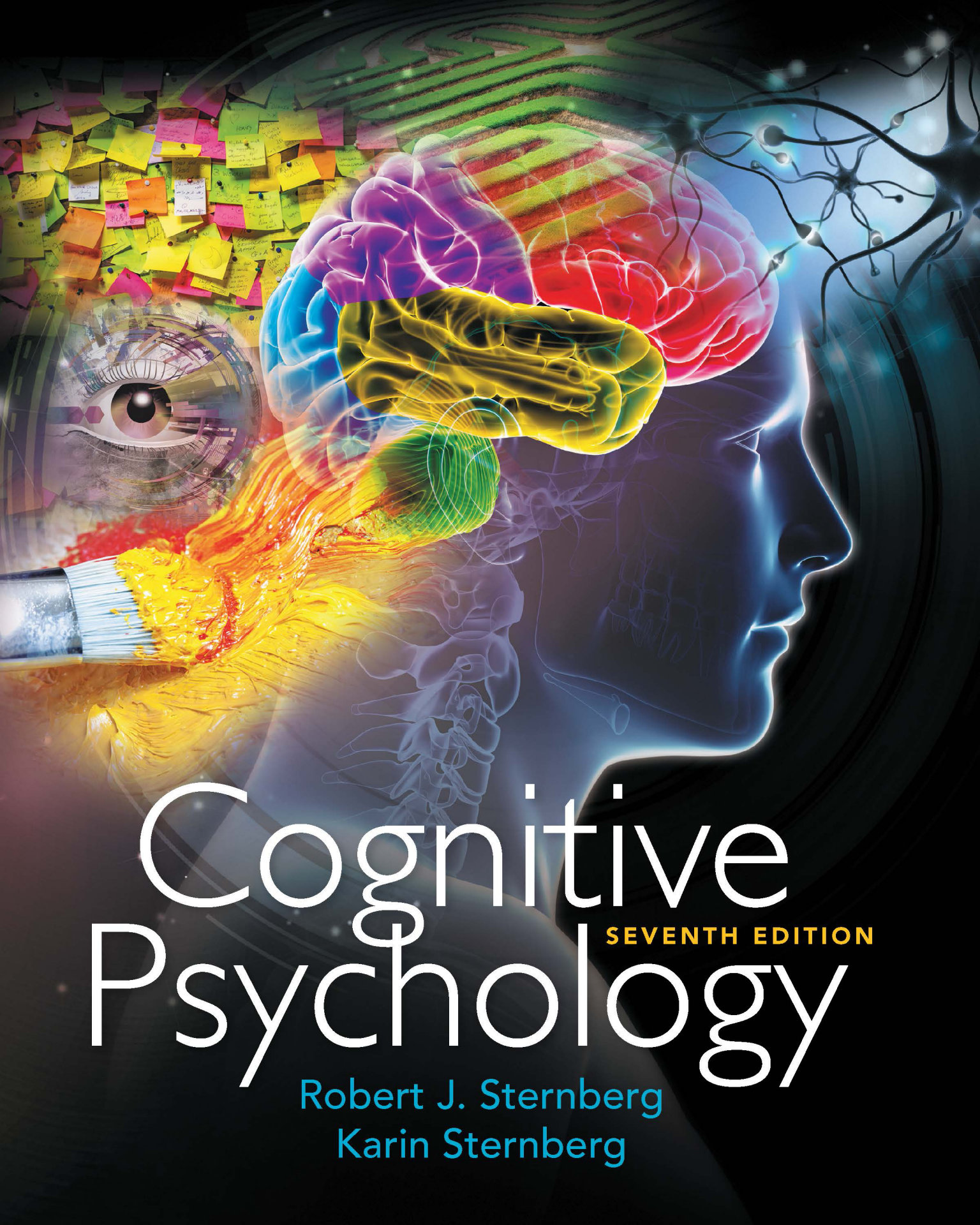

Cognitive Psychology

SEVENTH EDITION

Robert J. Sternberg
Karin Sternberg

7th Edition

Cognitive Psychology

7th Edition

Cognitive Psychology

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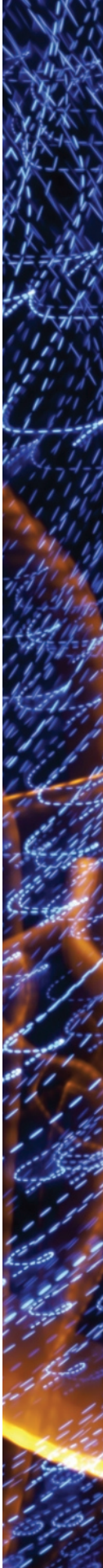

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Preface

To the Instructor

Welcome to the seventh edition of *Cognitive Psychology.* As you have likely noticed, this new edition is now published in four-color print. This greatly enhances the visual appeal of the book and also allows for a whole new level of detail in the images of the book. Most of the images in the book have been replaced or reworked to function even better as learning aids.

A major focus of this revision was the readability and understandability of the text. We have rewritten and modified many sections and have deleted or shortened a number of tables that were long.

In the following sections, we will outline the changes we made to give you an overview of this new edition.

Please also note the section on ancillaries. These materials have been developed to assist you in teaching your cognitive psychology class. A number of resources are available, which are listed in the following sections. We have included additional Internet addresses to the resources interest to students, including virtual tours of a magnetic resonance imaging (MRI) machine, a story about a snowboarder with a traumatic brain injury, and visual description of how to use transcranial magnetic stimulation (TMI) for the treatment of depression.

Goals of this Book

Cognitive psychologists study a wide range of psychological phenomena, such as perception, learning, memory, and thinking. In addition, cognitive psychologists study seemingly less cognitively oriented phenomena, such as emotion and motivation. In fact, almost any topic of psychological interest may be studied from a cognitive perspective. In this textbook, we describe some of the preliminary answers to questions asked by researchers in the main areas of cognitive psychology. The goals of this book are to accomplish the following:

- present the field of cognitive psychology in a comprehensive but engaging manner;
- integrate the presentation of the field under the general banner of human intelligence; and
- interweave throughout the text key themes and key ideas that permeate cognitive psychology.

Mission in Revising the Text

When revising the book, we had a number of goals that guided us through the revision, such as the following:

- make the text more accessible and understandable;
- make cognitive psychology more fascinating and less intimidating;

- better integrate coverage of cognitive neuroscience in each chapter; and
- develop appealing images, illustrations, and tables.

Major Organizing and Special Pedagogical Features

Several of the features that characterize this textbook are as follows:

- "Believe It or Not" boxes that present incredible and exciting information and facts from the world of cognitive psychology.
- "Practical Applications of Cognitive Psychology" boxes that help students think about applications of cognitive psychology in their own lives.
- "Investigating Cognitive Psychology" boxes that present mini-experiments and tasks that students can complete on their own.
- "Neuroscience and . . . " features included in at least one section per chapter to highlight the presentation of neuroscientific material.
- Concept checks after each major section to help students quickly check their comprehension of the material.

New to the Seventh Edition

Following is an overview of what changes you generally can expect in this edition followed by details of what was changed in each chapter:

- All In-the-Lab boxes were revised and two are completely new: Chapter 7, In the Lab of Doug Medin and Chapter 13, In the Lab of Ian Deary.
- By popular demand, the content on human and artificial intelligence has been removed from the 12 chapters and is now presented again in a separate chapter at the end of the book (Chapter 13, Human Intelligence).
- The book is now printed in four colors.
- Almost all figures and images have been replaced, revised, or adjusted.
- The language has been reviewed and many sections changed or rewritten to facilitate reading comprehension.
- We have added fun new websites to the instructor's manual and companion website to encourage readers to delve deeper into some matters, like stories on traumatic brain damage, a virtual tour of an MRI, and the story of famous neurologic patient H. M.
- The entire text has been rigorously updated.

And finally, here are the detailed changes for each chapter:

Chapter 1

- Rewrote the definition of heuristics and parts of Cognitive Psychology Defined to facilitate comprehension
- Added a figure about the roots of cognitive psychology
- Updated sections on early dialectics in the psychology of cognition, structuralism, associationism, and behaviorism
- Added a new figure on the cycle of research

- Revised the section on experiments to facilitate comprehension
- Edited the Key Themes in Cognitive Psychology section

Chapter 2

- Updated the section on anatomy of the brain: forebrain, midbrain, hindbrain
- Updated section on cerebral cortex and reorganized information on the four lobes to facilitate comprehension
- Updated the sections on studying live nonhuman animals, metabolic imaging, and head injuries
- Added new description of new imaging techniques, including a combination of functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG), functional transcranial Doppler sonography (fTCD), and near-infrared spectroscopy (NIRS)

Chapter 3

- Updated the introduction to clarify the difference between sensation and perception
- Updated the section on the what and where pathways
- Extended the explanation on Selfridge's feature-matching model to facilitate comprehension
- Updated the section on physiology of the eye to facilitate comprehension
- Updated the section on feature matching theories
- Add a new section on CAPTCHAs (Completely Automated Public Turing Test to Tell Computers and Humans Apart) to illustrate template theories
- Updated the sections on geons, viewer-dependent versus object-dependent representation, prosopagnosia, size constancy, shape constancy, and optic ataxia
- Added a new section on recognition of emotions in faces in people with schizophrenia to the section on face perception
- Updated the section on perception in practice

Chapter 4

- Updated the section on the nature of attention and consciousness
- Reorganized and streamlined Table 4.1 on the four main functions of attention
- Updated, shortened, and rewrote the section on search to facilitate comprehension
- Revised the section on selective attention
- Reorganized and revised the section on divided attention
- Added new research about cell phone use or texting and driving to the section on divided attention
- Updated the section on spatial neglect
- Updated the section on attention deficit hyperactivity disorder (ADHD)
- Extended the figure caption for Treisman's and Broadbent's model to facilitate comprehension

Chapter 5

- Restructured Table 5.1 on tasks for measuring memory
- Enhanced coverage of working memory
- Added new sections on alternative models of working memory, neuroscience of working memory, and amnesia research to support distinction between short-term and long-term memory
- Added research on bilingualism to the section on central executive, on how memories are stored, and on formation of new synapses or loss of synapses and brain oscillations

Chapter 6

- Revised discussion of short-term storage
- Revised discussion of Roediger's study on mnemonic devices
- Revised the section on mnemonic devices
- Updated coverage of retrieval from short-term memory
- Added new coverage of connection between encoding specificity and levels of processing approach, as well as brain research to the section on memory consolidation
- Added new research on encoding specificity, reality monitoring and autobiographical memory, sleep and memory consolidation, mnemonic devices, interference theory, and flashbulb memory

Chapter 7

- Redesigned Table 7.1 on propositional representations to facilitate comprehension
- Added a new section to mental maps section
- Added an all-new discussion of neuroscience and functional equivalence
- Updated and expanded the sections on neuroscience and mental rotation, gender differences in mental rotation, and image scanning
- Added a discussion of research on border bias to the section on cognitive maps

Chapter 8

- Clarified the difference between concepts and categories
- Clarified difference between prototypes and exemplars
- Added family resemblance to the section on categorization
- Expanded the explanation of concepts
- Updated the sections on essentialism, network models, schemas and scripts, typicality effect, adaptive control of thought–rational (ACT-R), and parallel distributed processing (PDP)
- Added boundary extension to the section about schemas
- Enhanced the discussion of the differences between connectionist and network representations and their differences with respect to learning

Chapter 9

- Updated sections on properties of language, number of spoken languages in the world, and examples of newly coined words
- Streamlined and updated sections on basic components of words, speech perception as special, and speech perception as ordinary
- Rewrote parts of the section on transformational grammar to facilitate comprehension
- Added a section on basic approaches to teaching reading
- Reorganized the section on reading
- Added Zwaan's simulation model to representing text in mental models

Chapter 10

- Updated the section on verbal overshadowing effect and bilingualism
- Streamlined and updated sections on Sapir-Whorf hypothesis and linguistic relativity and universals, metaphors, the brain and language, and autism spectrum disorder and language
- Eliminated the section on speech acts

Chapter 11

- Added a new table to better represent the drug problem in the beginning of the chapter and elaborated on the description of the problem
- Added definitions and explanations of key words like initial state, goal state, and obstacles
- Updated the section on problem-solving cycle
- Extended the explanation of and figures on the Tower of Hanoi
- Added a new figure to illustrate the concept of problem space
- Updated the section on types of problems
- Added Duncker's candle problem and two figures illustrating the concept
- Added stereotype threat to the section on mental sets, entrenchment, and fixation
- Added a new section on embodied cognition and problem solving
- Rewrote the transfer of analogies section
- Redesigned Table 11.2 about correspondence between radiation and military problem
- Updated research on analogical problem solving and incubation
- Revised the section on expertise to facilitate comprehension
- Added a new section on expertise and long-term working memory
- Updated the section on creativity

Chapter 12

- Extended and updated information relating to everyday life in sections on availability, satisficing, and anchoring heuristics as well as framing effect
- Extended the explanation in the vaccine example of a framing effect

- Added a new section on myside bias to the section on biases
- Added a new section on maximizers and satisficers and the effects of their strategies on their well-being
- Updated sections on hindsight bias, gambler's fallacy, and conjunction fallacy
- Extended and updated the section on conditional reasoning in everyday life

Chapter 13

- Added separate chapter to discuss human and artificial intelligence

Ancillaries

As an instructor, you have a multitude of resources available to you to assist you in the teaching of your class. Here is a list of materials you can use:

Instructor's Manual with Test Bank—The Instructor's Manual contains chapter outlines, in-class demonstrations, discussion topics, and suggested websites. The Test Bank includes approximately 75 multiple-choice and 20 short-answer questions per chapter. Each multiple-choice item is labeled with the page reference and level of difficulty.

PowerPoint Presentation Tool—With this one-stop presentation tool, instructors can assemble, edit, and present custom lectures with ease. This tool includes figures and tables from the text, as well as preassembled Microsoft PowerPoint lecture slides. Instructors can use the material or add their own material for a truly customized lecture presentation.

CogLab 5.0—CogLab 5.0 lets students do more than just think about cognition. CogLab 5.0 uses the power of the web to teach concepts using important classic and current experiments that demonstrate how the mind works. Nothing is more powerful for students than seeing the effects of these experiments for themselves. This resources includes such features as simplified student registration, a global database that combines data from students all around the world, between-subject designs that allow for new kinds of experiments, and a quick display of student summaries. Also included are trial-by-trial data, standard deviations, and improved instructions.

When you adopt Sternberg's *Cognitive Psychology*, 7e, you will have access to a rich array of online teaching and learning resources that you won't find anywhere else.

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Foreword

To the Student

Why do we remember people whom we met years ago, but sometimes seem to forget what we learned in a course shortly after we take the final exam (or worse, sometimes right before)? How do we manage to carry on a conversation with one person at a party and simultaneously eavesdrop on another more interesting conversation taking place nearby? Why are people so often certain that they are correct in answering a question when in fact they are not? These are just three of the many questions that are addressed by the field of cognitive psychology.

Cognitive psychologists study how people perceive, learn, remember, and think. Although cognitive psychology is a unified field, it draws on many other fields, most notably neuroscience, computer science, linguistics, anthropology, and philosophy. Thus, you will find some of the thinking of all these fields represented in this book. Moreover, cognitive psychology interacts with other fields within psychology, such as cognitive neuroscience, developmental psychology, social psychology, and clinical psychology.

For example, it is difficult to be a clinical psychologist in the twenty-first century without a solid knowledge of developments in cognitive psychology because so much of the thinking in the clinical field draws on cognitive ideas, both in diagnosis and in therapy. Cognitive psychology also has provided a means for psychologists to investigate experimentally some of the exciting ideas that have emerged from clinical theory and practice, such as notions of unconscious thought.

Cognitive psychology will be important to you not only in its own right but also in helping you in all of your work. For example, knowledge of cognitive psychology can help you better understand how best to study for tests, how to read effectively, and how to remember difficult-to-learn material.

Cognitive psychologists study a wide range of psychological phenomena, such as perception, learning, memory, and thinking. In addition, cognitive psychologists study seemingly less cognitively oriented phenomena, such as emotion and motivation. In fact, almost any topic of psychological interest may be studied from a cognitive perspective. In this textbook, we describe some of the preliminary answers to questions asked by researchers in the main areas of cognitive psychology.

- Chapter 1, *Introduction to Cognitive Psychology:* What are the origins of cognitive psychology, and how do people do research in this field?
- Chapter 2, *Cognitive Neuroscience:* What structures and processes of the human brain underlie the structures and processes of human cognition?
- Chapter 3, *Visual Perception:* How does the human mind perceive what the senses receive? How does the human mind perceive forms and patterns?
- Chapter 4, *Attention and Consciousness:* What basic processes of the mind govern how information enters our minds, our awareness, and our high-level processes of information handling?

- Chapter 5, *Memory: Models and Research Methods:* How are different kinds of information (e.g., our experiences related to a traumatic event, the names of U.S. presidents, or the procedure for riding a bicycle) represented in memory?
- Chapter 6, *Memory Processes:* How do we move information into memory, keep it there, and retrieve it from memory when needed?
- Chapter 7, *Mental Images and Propositions:* How do we mentally represent information in our minds? Do we do so in words, in pictures, or in some other form representing meaning? Do we have multiple forms of representation?
- Chapter 8, *The Organization of Knowledge in the Mind:* How do we mentally organize what we know?
- Chapter 9, *Language:* How do we derive and produce meaning through language? How do we acquire language—both our primary language and any additional languages?
- Chapter 10, *Language in Context:* How does our use of language interact with our ways of thinking? How does our social world interact with our use of language?
- Chapter 11, *Problem Solving and Creativity:* How do we solve problems? What processes aid and impede us in reaching solutions to problems? Why are some of us more creative than others? How do we become and remain creative?
- Chapter 12, *Decision Making and Reasoning:* How do we reach important decisions? How do we draw reasonable conclusions from the information we have available? Why and how do we so often make inappropriate decisions and reach inaccurate conclusions?
- Chapter 13, *Human Intelligence:* What is intelligence? How can we measure intelligence? Can intelligence be improved?

To acquire the knowledge outlined in the previous list, we suggest you make use of the following pedagogical features of this book:

1. *Chapter outlines,* beginning each chapter, summarize the main topics covered and thus give you an advance overview of what is to be covered in that chapter.
2. *Opening questions* emphasize the main questions each chapter addresses.
3. *Boldface terms,* indexed at the ends of chapters and defined in the glossary, help you acquire the vocabulary of cognitive psychology.
4. *End-of-chapter summaries* return to the questions at the opening of each chapter and show our current state of knowledge with regard to these questions.
5. *End-of-chapter questions* help you ensure both that you have learned the basic material and that you can think in a variety of ways (factual, analytical, creative, and practical) with this material.
6. *"Investigating Cognitive Psychology" demonstrations,* appearing throughout the chapters, help you see how cognitive psychology can be used to demonstrate various psychological phenomena.
7. *"Practical Applications of Cognitive Psychology" demonstrations* show how you and others can apply cognitive psychology to your everyday lives.
8. *"In the Lab of . . . " boxes* tell you what it really is like to do research in cognitive psychology. Prominent researchers speak in their own words about their research—what research problems excite them most and what they are doing to address these problems.
9. "*Believe It or Not" boxes* present incredible and exciting information and facts from the world of cognitive psychology.

10. *Key Themes sections,* near the end of each chapter, relate the content of the chapters to the key themes expressed in Chapter 1. These sections will help you see the continuity of the main ideas of cognitive psychology across its various subfields.
11. *CogLab,* an exciting series of laboratory demonstrations in cognitive psychology provided by the publisher of this textbook (Cengage Learning), is available for purchase with this text. You can actively participate in these demonstrations and thereby learn firsthand what it is like to be involved in cognitive-psychological research.

This book contains an overriding theme that unifies all of the diverse topics found in the various chapters: Human cognition has evolved over time as a means of adapting to our environment, and we can call this ability to adapt to the environment *intelligence.* Through intelligence, we cope in an integrated and adaptive way with the many challenges with which the environment presents us.

Although cognitive psychologists disagree about many issues, there is one issue about which almost all of them agree; namely, cognition enables us to successfully adapt to the environments in which we find ourselves. Thus, we need a construct such as that of *human intelligence,* if only to provide a shorthand way of expressing this fundamental unity of adaptive skill. We can see this unity at all levels in the study of cognitive psychology. For example, diverse measures of the psychophysiological functioning of the human brain show correlations with scores on a variety of tests of intelligence. Selective attention, the ability to tune in certain stimuli and tune out others, is also related to intelligence, and it has even been proposed that an intelligent person is one who knows what information to attend to and what information to ignore. Various language and problem-solving skills also are related to intelligence, pretty much without regard to how it is measured. In brief, then, human intelligence can be seen as an entity that unifies and provides direction to the workings of the human cognitive system.

We hope you enjoy this book, and we hope you see why we are enthusiastic about cognitive psychology and proud to be cognitive psychologists.

About the **Authors**

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He has received numerous awards, including the James McKeen Cattell Award from the American Psychological Society; the Early Career and McCandless Awards from the American Psychological Association (APA); and the Outstanding Book, Research Review, Sylvia Scribner, and Palmer O. Johnson Awards from the American Educational Research Association.

Dr. Sternberg has served as president of the APA, the Eastern Psychological Association, and the Federation of Associations in Behavioral and Brain Sciences. He currently is editor of *Perspectives on Psychological Science* and previously was editor of the *Psychological Bulletin* and the *APA Review of Books: Contemporary Psychology.* He is a member of the American Academy of Arts and Sciences, the National Academy of Education, and the Society of Experimental Psychologists. He is a fellow of APA, Association for Psychological Science, and American Association for the Advancement of Science. He was the director of the Center for the Psychology of Abilities, Competencies, and Expertise at Yale University.

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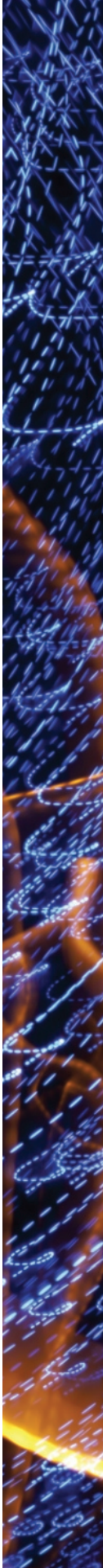
1 Introduction to Cognitive Psychology



CHAPTER OUTLINE

Cognitive Psychology Defined
Philosophical Origins of Psychology: Rationalism versus Empiricism
Psychological Origins of Cognitive Psychology
- Early Dialectics in the Psychology of Cognition
  - Understanding the Structure of the Mind: Structuralism
  - Understanding the Processes of the Mind: Functionalism
  - An Integrative Synthesis: Associationism
- It's Only What You Can See That Counts: From Associationism to Behaviorism
  - Proponents of Behaviorism
  - Criticisms of Behaviorism
  - Behaviorists Daring to Peek into the Black Box
- The Whole Is More Than the Sum of Its Parts: Gestalt Psychology

Emergence of Cognitive Psychology
- Early Role of Cognitive Neuroscience
- Add a Dash of Technology: Engineering, Computation, and Applied Cognitive Psychology

Research Methods in Cognitive Psychology
- Goals of Research
- Distinctive Research Methods
  - Experiments on Human Behavior
  - Neuroscientific Research
  - Self-Reports, Case Studies, and Naturalistic Observation
  - Computer Simulations and Artificial Intelligence
  - Putting It All Together

Fundamental Ideas in Cognitive Psychology
Key Themes in Cognitive Psychology
Summary
Thinking about Thinking: Analytical, Creative, and Practical Questions
Key Terms

Here are some of the questions we will explore in this chapter:

1. What is cognitive psychology?
2. How did psychology develop as a science?
3. How did cognitive psychology develop from psychology?
4. How have other disciplines contributed to the development of theory and research in cognitive psychology?
5. What methods do cognitive psychologists use to study how people think?
6. What are the current issues and various fields of study within cognitive psychology?

BELIEVE IT OR NOT | Now You See It, Now You Don't!

Note: Do not read on before you have watched the video.

Cognitive psychology yields all kinds of surprising findings. Dan Simons of the University of Illinois is a master of surprises (see Simons, 2007; Simons & Ambinder, 2005; Simons & Rensink, 2005). Try it out yourself! Watch the following videos and see if you have any comments on them.

viscog.beckman.illinois.edu/flashmovie/23.php

Did you notice that the person who answers the phone is not the same as the one who was at the desk? Note that they are wearing distinctively different clothing. You have just seen an example of change blindness—our occasional inability to recognize changes. You will learn more about this concept in Chapter 3.

Now view the following video. Your task will be to count the number of times that students in *white shirts* pass the basketball. You must not count passes by students wearing black shirts:

viscog.beckman.illinois.edu/flashmovie/15.php

Well, it doesn't really matter how many passes there were. Did you notice the person in the gorilla outfit walk across the video as the students were throwing the balls? Most people don't notice. This video demonstrates a phenomenon called *inattentional blindness*. You will learn more about this concept in Chapter 4. Throughout this book, we will explore these and many other phenomena.

Think back to the last time you went to a party or social gathering. There were probably tens and maybe hundreds of students in a relatively small room. Maybe music played in the background, and you could hear chatter all around. Yet, when you talked to your friends, you were able to figure out and even concentrate on what they said, filtering out all the other conversations that were going on in the background. Suddenly, however, your attention might have shifted because you heard someone in another conversation nearby mention your name. What processes would have been at work in this situation? How were you able to filter out irrelevant voices in your mind and focus your attention on just one of the many voices you heard? And why did you notice your name being mentioned, even though you did not purposefully listen to the conversations around you? Our ability to focus on one out of many voices is one of the most striking phenomena in cognitive psychology, and this phenomenon is known as the "cocktail party effect."

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When you are at a party, you are usually able to filter out many irrelevant voice streams to concentrate on the conversation you are leading. However, you will likely notice somebody saying your name in another conversation even if you were not listening intently to that conversation.

Cognitive processes are continuously taking place in your mind and in the minds of the people around you. Whether you pay attention to a conversation, estimate the speed of an approaching car when crossing the street, or memorize information for a test at school, you are perceiving information, processing it, and remembering or thinking about it. This book is about those cognitive processes that are often hidden in plain sight and that we take for granted because they seem so automatic to us. This chapter will introduce you to some of the people who helped form the field of cognitive psychology and make it what it is today. The chapter also will discuss methods used in cognitive-psychological research.

Cognitive Psychology Defined

What will you study in a textbook about cognitive psychology?

Cognitive psychology is the study of how people perceive, learn, remember, and think about information. A cognitive psychologist might study how people perceive various shapes, why they remember some facts but forget others, or how they learn language. Consider some examples:

- Why do objects look farther away on foggy days than they really are?
- Why do many people remember a particular experience (e.g., a very happy moment or an embarrassment during childhood), yet they forget the names of people whom they have known for many years?
- Why are many people more afraid of traveling in planes than in automobiles?

- Why do you often easily remember people you met in your childhood but not people you met a week ago?
- Why do marketing executives in large companies spend so much company money on advertisements?

These are some of the kinds of questions that we can answer through the study of cognitive psychology.

Consider just the last of these questions: Why does Apple, for example, spend so much money on advertisements for its iPhone? After all, how many people remember the functional details of the iPhone, or how those functions distinguish it from the functions of other phones? One reason Apple spends so much is because of the *availability heuristic*, which you will study in Chapter 12. **Heuristics** are mental shortcuts we use to process information. When we think about an issue and certain examples immediately come to mind, we are using the "availability heuristic" (Tversky & Kahneman, 1973). For example, when we are thinking about buying a new cell phone, we are much more likely to buy a brand and model of a phone that is familiar. Similarly, Microsoft paid a lot of money to market its rollout of Windows 8.1 to make the product cognitively available to potential customers and thus increase the chances that the potential customers would become actual ones. The bottom line is that understanding cognitive psychology can help us understand much of what goes on in our everyday lives.

Why study the history of cognitive psychology? If we know where we came from, we may better understand where we are heading. In addition, we can learn from past mistakes. For example, there are numerous newspaper stories about how one educational program or another has resulted in particular gains in student achievement. It is relatively rare, however, to read that a control group has been used. A control group might tell us about the achievement of students who did not have that educational program or who were in an alternative program. It may be that these students also showed a gain. We need to compare the students in the experimental group to those in the control group to determine whether the gain of the students in the experimental group was greater than the gain of those in the control group. We can learn from the history of our field that it is important to include control groups, but not everyone learns this fact.

The fundamental questions in cognitive psychology remain the same, but the ways of addressing these issues have changed. Ultimately, cognitive psychologists hope to learn how people think by studying how people have thoughts about thinking.

The approaches and ways scientists use to study issues in cognitive psychology change over time. These changes often are the result of a dialectic. A **dialectic** is a developmental process whereby ideas evolve over time through a back-and-forth exchange of ideas; in a way, it is like a discussion spread out over an extended period of time. The dialectical process looks like this:

1. **A thesis is proposed.** A *thesis* is a statement of belief. For example, some people believe that human nature (i.e., the effects of our genes) influences many aspects of human behavior (e.g., intelligence or personality; Sternberg, 1999). After a while, however, certain individuals notice apparent flaws in the thesis.
2. **An antithesis emerges.** Eventually, or perhaps even quite soon, an antithesis emerges. An *antithesis* is a statement that counters a thesis. For example, an alternative view is that our environment (whose effects are called "nurture") almost entirely determines many aspects of human behavior.
3. **A synthesis integrates the viewpoints.** Sooner or later, the debate between the thesis and the antithesis leads to a synthesis, which integrates the most credible features of each of two (or more) views. For example, in the debate over nature

versus nurture, the interaction between our innate (inborn) nature and environmental nurture may govern human nature.

The dialectic is important because we may be tempted to think that if one view is right, another seemingly contrasting view must be wrong. For example, in the field of **intelligence**, many tend to believe that intelligence is either all or mostly genetically determined, or all or mostly environmentally determined. A similar debate has raged in the field of language acquisition. It is better to examine such issues as different forces that interact with and influence each other than to view these issues as either–or questions. Indeed, the most widely accepted current contention is that the "nature or nurture" view is incomplete. Nature and nurture work together in our development.

Nurture can work in different ways in different cultures. Some cultures, especially Asian cultures, tend to be more dialectical in their thinking, whereas other cultures, such as European and North American ones, tend to be more linear (Nisbett, 2003). In other words, Asians are more likely to be tolerant of holding beliefs that are contradictory, expecting that at some point a resolution will resolve the conflict in their beliefs. Europeans and Americans expect their belief systems to be consistent with each other.

Similarly, people from Asian cultures tend to take a different viewpoint than Westerners when seeing or hearing something new (e.g., a movie of fish in an ocean; Nisbett & Masuda, 2003). So if people see a movie of fish swimming around in the ocean, Europeans or Americans will tend to pay more attention to the fish, and Asians may attend more to the surround of the ocean in which the fish are swimming. That is, people from Western cultures generally tend to process objects independently of the context, whereas people from many Eastern cultures look at objects embedded in their surrounding context (Nisbett & Miyamoto, 2005). Asians may emphasize the context more than the objects embedded in those contexts. The evidence suggests that culture influences many cognitive processes, including intelligence (Lehman, Chiu, & Schaller, 2004).

If a synthesis advances our understanding of a subject, it then serves as a new thesis. A new antithesis then follows it, then a new synthesis, and so on. You will see in this chapter that psychology also evolved as a result of dialectics: Psychologists had ideas about how the mind works and pursued their line of research; then other psychologists pointed out weaknesses and developed alternatives as a reaction to the earlier ideas. Eventually, characteristics of the different approaches are often integrated into a newer and more encompassing approach.

Philosophical Origins of Psychology: Rationalism versus Empiricism

Where and when did the study of cognitive psychology begin? Historians of psychology usually trace the earliest roots of psychology to two approaches to understanding the human mind:

- *philosophy,* which seeks to understand the general nature of many aspects of the world, in part through *introspection*, the examination of inner ideas and experiences (from *intro*, "inward, within," and *spect*, "look")
- *physiology,* which seeks a scientific study of life-sustaining functions in living matter, primarily through *empirical* (observation based) methods

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■ **Figure 1.1 Rationalism and Empiricism.** (a) According to the rationalist, the only route to truth is reasoned contemplation; (b) according to the empiricist, the only route to truth is meticulous observation. Cognitive psychology, like other sciences, depends on the work of both rationalists and empiricists.

Two Greek philosophers, Plato (ca. 428–348 B.C.) and his student Aristotle (384–322 B.C.), have profoundly affected modern thinking in psychology and many other fields. Plato and Aristotle disagreed regarding how to investigate ideas.

Plato was a rationalist. A **rationalist** believes that the route to knowledge is through thinking and logical analysis. That is, a rationalist does not need any experiments to develop new knowledge. A rationalist who is interested in cognitive processes would appeal to reason as a source of knowledge or justification.

In contrast, Aristotle (a naturalist and biologist as well as a philosopher) was an empiricist. An **empiricist** believes that we acquire knowledge via empirical evidence—that is, we obtain evidence through experience and observation (Figure 1.1 ■). To explore how the human mind works, empiricists would design experiments and conduct studies in which they could observe the behavior and processes of interest to them. Empiricism therefore leads directly to empirical investigations of psychology. Later in this chapter, we will discuss the empirical research methods that are used in cognitive psychology.

In contrast, rationalism is important in theory development. Rationalist theories without any connection to observations gained through empiricist methods may not be valid; but mountains of observational data without an organizing theoretical framework may not be meaningful. We might see the rationalist view of the world as a thesis and the empirical view as an antithesis. Most twenty-first-century psychologists seek a synthesis of the two. They base empirical observations on theory to explain what they have observed in their experiments. In turn, they use these observations to revise their theories when they find that the theories cannot account for their real-world observations.

The contrasting ideas of rationalism and empiricism became prominent with the French rationalist René Descartes (1596–1650) and the British empiricist John Locke (1632–1704). Descartes viewed the introspective, reflective method as being superior to empirical methods for finding truth. The famous expression *cogito, ergo sum* (I think, therefore I am) stems from Descartes. He maintained that the only proof of his existence is that he was thinking and doubting. Descartes felt that one could not rely on one's senses because those very senses have often proven to be deceptive (e.g., think of optical illusions). Locke, in contrast, had more enthusiasm for empirical observation (Leahey, 2003). Locke believed that humans are born without knowledge and therefore must seek knowledge through empirical observation. Locke's term for this view was *tabula rasa* (meaning "blank slate" in Latin). The idea is that life and experience "write" knowledge

on us. For Locke, then, the study of learning was the key to understanding the human mind. He believed that there are no innate ideas.

In the eighteenth century, German philosopher Immanuel Kant (1724–1804) synthesized the views of Descartes and Locke, arguing that both rationalism and empiricism have their place. Both must work together in the quest for truth. Most twenty-first-century psychologists accept Kant's synthesis. The roots of cognitive psychology discussed here and in the next sections are summarized in Figure 1.2 ■.

Psychological Origins of Cognitive Psychology

Cognitive psychology has roots in many different ideas and approaches (see, e.g., King, Woody, & Viney, 2013; Leahey, 2012). The approaches that will be examined include early approaches such as structuralism and functionalism, followed by a discussion of associationism, behaviorism, and Gestalt psychology.

Early Dialectics in the Psychology of Cognition

Psychology only recently emerged as a new and independent field of study (Hergenhahn & Henley, 2013). It developed in a dialectical way. Typically, an approach to studying the mind would be developed; people then would use it to explore the human psyche. At some point, however, researchers would find that the approach they used had some weaknesses, or they would disagree with some fundamental assumptions of that approach. They then would develop a new approach. Future approaches might integrate the best features of past approaches or reject some or even most of those characteristics. In the following section, we will explore some of the ways of thinking early psychologists employed and trace the development of psychology through the various schools of thinking. Take note that there is not, and never has been, just one right approach to studying cognitive psychology. Rather, researchers have used one or more approaches as bases for their work but also appreciated the value of other approaches.

Understanding the Structure of the Mind: Structuralism

An early dialectic in the history of psychology is that between structuralism and functionalism (Kardas, 2013; Leahey, 2012; Morawski, 2000). Structuralism was the first major school of thought in psychology. **Structuralism** seeks to understand the structure (configuration of elements) of the mind and its perceptions by analyzing those perceptions into their constituent components (affection, attention, memory, and sensation).

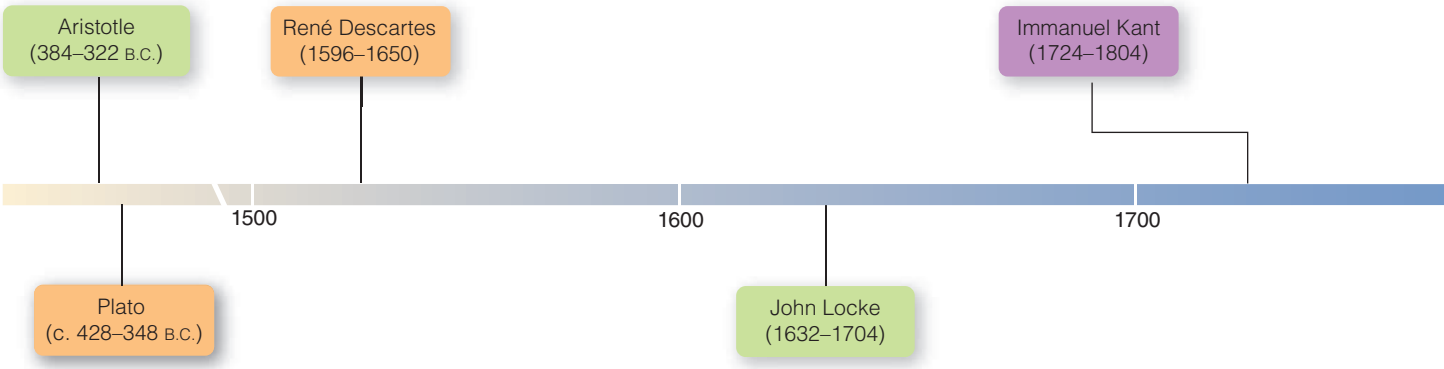
Consider, for example, the perception of a flower. Structuralists would analyze this perception in terms of its colors, geometric forms, size relations, and so on. In terms of the human mind, structuralists sought to deconstruct the mind into its elementary components; they were also interested in how those elementary components work together to create the mind (Benjamin, 2014).

Wilhelm Wundt (1832–1920) was a German psychologist whose ideas contributed to the development of structuralism (Wertheimer, 2011). Wundt is often viewed as the founder of structuralism in psychology (Structuralism, 2009). Wundt used a variety of methods in his research. One of these methods was introspection. **Introspection** is the conscious observation of one's own thinking processes. The aim of introspection is to look at the elementary components of an object or process.

Archives of the History of American Psychology—University of Akron

Wilhelm Wundt was no great success in school, failing time and again and frequently finding himself subject to the ridicule of others. However, Wundt later showed that school performance does not always predict career success because he is considered to be among the most influential psychologists of all time.

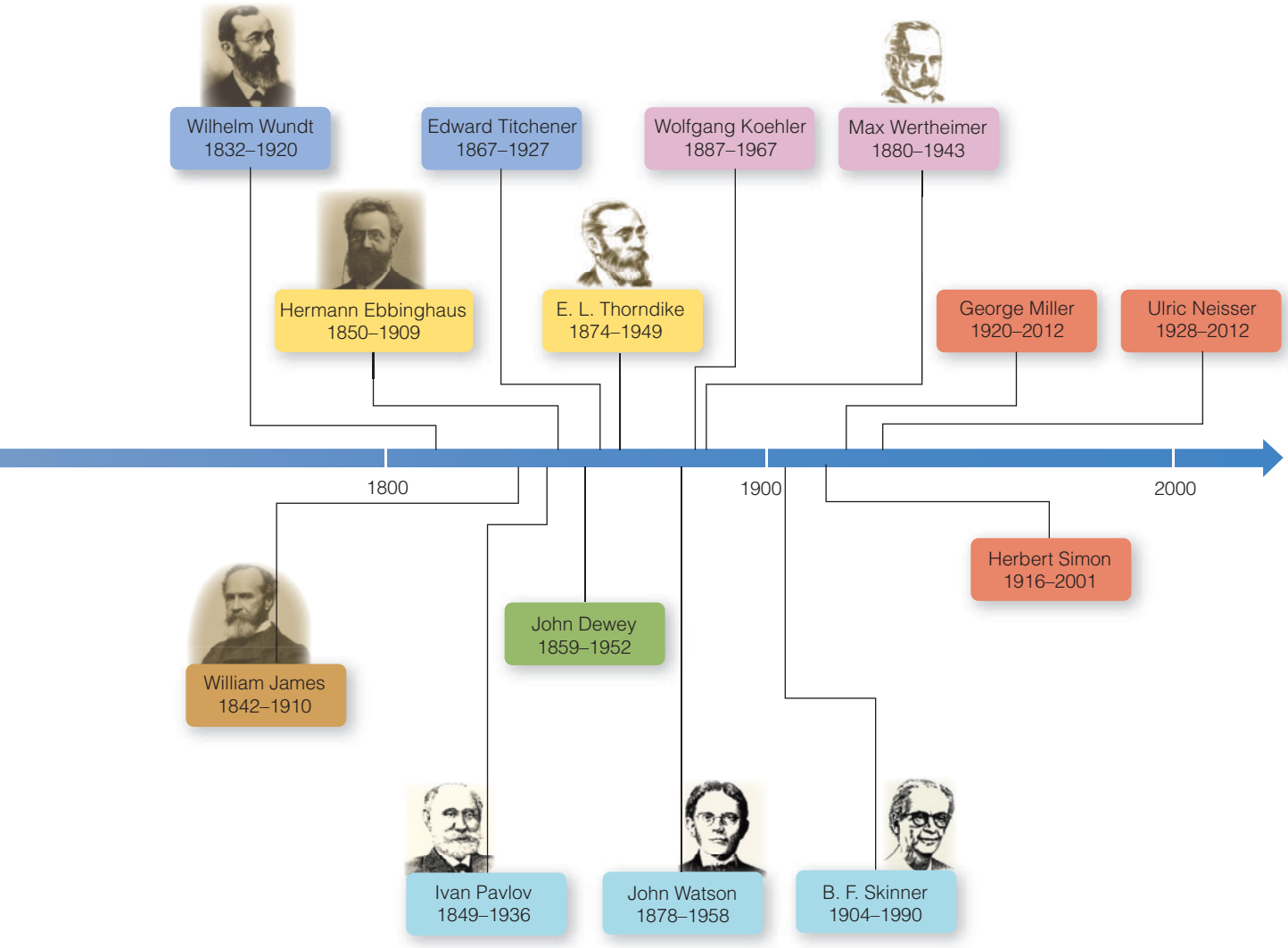
Methods To Gain Knowledge	How Knowledge Is Gained
Rationalism	Through reflective thinking and logical analysis
Empiricism	Through observation
Synthesis	Through the use of observation as well as thinking and logical analysis



Approaches to Studying the Mind	Methods Used	What Is Studied
Structuralism	Introspection	Content/structure of the mind
Functionalism	Various; depends on question asked	Processes of how the mind works
Pragmatism	Various	Research that can be applied to the real world
Synthesis: Associationism	Experiments: Ebbinghaus used himself as a subject; Thorndike used cats as well as humans.	How learning takes place by associating things with each other
Behaviorism (extreme form of associationism)	Use of animals in research in addition to humans Quantitative analysis	Relations between observable behavior and environmental events/stimuli
Gestalt psychology	Introspection, experiments	Psychological phenomena studied as organized wholes
Synthesis: Cognitivism	Experiments, computer simulation, protocol analysis	Understand behavior through the ways people think

Figure 1.2 Roots of Cognitive Psychology.

The introduction of introspection as an experimental method was an important change in the field because the main emphasis in the study of the mind shifted from a rationalist approach to the empiricist approach of observing behavior to draw conclusions about the subject of study. In experiments involving introspection, individuals reported on their thoughts as they were working on a given task (Goodwin, 2011). Researchers interested in problem solving could ask their participants to think aloud while they were working on a puzzle so the researchers could gain insight into the thoughts that go on in the participants' minds. In introspection, then, we can analyze our own perceptions.



The method of introspection has some challenges associated with it. First, people may not always be able to say exactly what goes through their mind or may not be able to put it into adequate words. Second, what they say may not be accurate. Third, the fact that people are asked to pay attention to their thoughts or to speak out loud while they are working on a task may itself alter the processes that are going on.

Wundt had many followers. One was an American student, Edward Titchener (1867–1927). Titchener (1910) is sometimes viewed as the first full-fledged structuralist. In any case, he certainly helped bring structuralism to the United States. His experiments relied solely on the use of introspection, exploring psychology from the vantage point of the experiencing individual. Other early psychologists criticized both the method (introspection) and the focus (elementary structures of sensation) of structuralism. These critiques gave rise to a new movement—functionalism.

Understanding the Processes of the Mind: Functionalism

Functionalism was developed as an alternative to structuralism, and suggested that psychologists should focus on the *processes* of thought rather than on its contents. **Functionalism** seeks to understand what people *do* and *why* they do it. This principal