An aerial night photograph of a city, likely New York City, showing a dense grid of streets illuminated by yellow and white lights. The lights create a complex, interconnected pattern against the dark background of the city and surrounding areas. The overall effect is a vibrant, glowing map of urban infrastructure.

DANIEL REISBERG

7E

COGNITION

EXPLORING THE SCIENCE OF THE MIND

Cognition

seventh edition

Cognition

7e

exploring the science of the mind

Daniel Reisberg

REED COLLEGE



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With love
— always —
for the family that
enriches every
aspect of my life.

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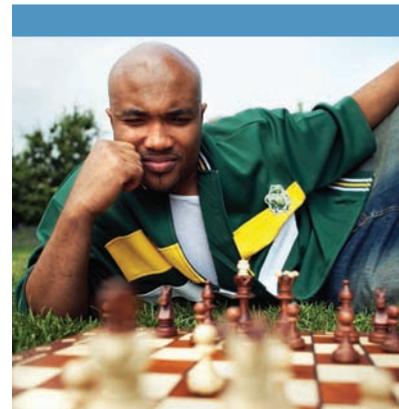
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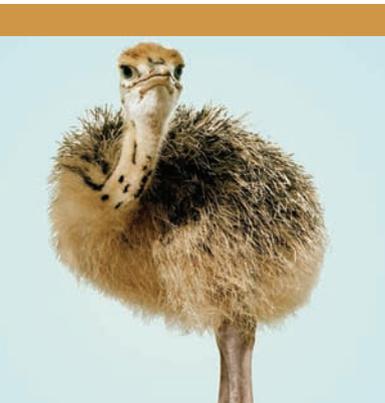
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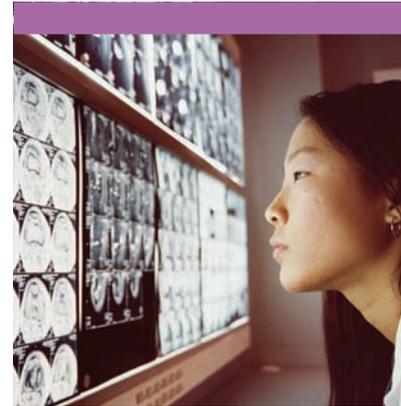
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Preface

I was a college sophomore when I took my first course in cognitive psychology. I was excited about the material then, and, many years later, the excitement hasn't faded. Part of the reason lies in the fact that cognitive psychologists are pursuing fabulous questions, questions that have intrigued humanity for thousands of years: Why do we think the things we think? Why do we believe the things we believe? What is “knowledge,” and how *secure* (how complete, how accurate) is our knowledge of the world around us?

Other questions asked by cognitive psychologists concern more immediate, personal, issues: How can I help myself to remember more of the material that I'm studying in my classes? Is there some better way to solve the problems I encounter? Why is it that my roommate can study with music on, but I can't?

And sometimes the questions have important consequences for our social or political institutions: If an eyewitness reports what he saw at a crime, should we trust him? If a newspaper raises questions about a candidate's integrity, how will voters react?

Of course, we want more than interesting questions—we also want *answers* to these questions, and this is another reason I find cognitive psychology so exciting. In the last half-century or so, the field has made extraordinary progress on many fronts, providing us with a rich understanding of the nature of memory, the processes of thought, and the content of knowledge. There are many things still to be discovered—that's part of the fun. Even so, we already have a lot to say about all of the questions just posed and many more as well. We can speak to the specific questions and to the general, to the theoretical issues and to the practical. Our research has uncovered principles useful for improving the process of education, and we have made discoveries of considerable importance for the criminal justice system. What I've learned as a cognitive psychologist has changed how I think about my own memory; it's changed how I make decisions; it's changed how I draw conclusions when I'm thinking about events in my life.

On top of all this, I'm also excited about the *connections* that cognitive psychology makes possible. In the academic world, intellectual disciplines are often isolated from one another, sometimes working on closely related problems

without even realizing it. In the last decades, though, cognitive psychology has forged rich connections with its neighboring disciplines, and in this book we'll touch on topics in philosophy, neuroscience, law and criminal justice, economics, linguistics, politics, computer science, and medicine. These connections bring obvious benefits, since insights and information can be traded back and forth between the domains. But these connections also highlight the importance of the material we'll be examining, since the connections make it clear that the issues before us are of interest to a wide range of scholars. This provides a strong signal that we're working on questions of considerable power and scope.

I've tried in this text to convey all this excitement. I've done my best to describe the questions being asked within my field, the substantial answers we can provide for these questions, and, finally, some indications of how cognitive psychology is (and has to be) interwoven with other intellectual endeavors.

I've also had other goals in writing this text. In my own teaching, I try to maintain a balance among many different elements: the nuts and bolts of how our science proceeds, the data provided by the science, the practical implications of our research findings, and the theoretical framework that holds all of these pieces together. I've tried to find the same balance in this text. Perhaps most important, though, I try, both in my teaching and throughout this book, to “tell a good story,” one that conveys how the various pieces of our field fit together into a coherent package. Of course, I want the evidence for our claims to be in view, so that readers can see how our field tests its hypotheses and why our claims must be taken seriously. But I've also put a strong emphasis on the flow of ideas—how new theories lead to new experiments, and how those experiments can lead to new theory.

The notion of “telling a good story” also emerges in another way: I've always been impressed by the ways in which the different parts of cognitive psychology are interlocked. Our claims about attention, for example, have immediate implications for how we can theorize about memory; our theories of object recognition are linked to our proposals for how knowledge is stored in the mind. Linkages like these are intellectually satisfying, because they ensure that the pieces of the puzzle really do fit together. But, in addition, these linkages make the material within cognitive psychology easier to learn, and easier to remember. Indeed, if I were to emphasize one crucial fact about memory, it would be that memory is best when the memorizer perceives the organization and interconnections within the material being learned. (We'll discuss this point further in Chapter 6.) With an eye on this point, I've therefore made sure to highlight the interconnections among various topics, so that readers can appreciate the beauty of our field and can also be helped in their learning by the orderly nature of our theorizing.

I've tried to help readers in other ways, too. First, I've tried throughout the book to make the prose approachable. I want my audience to gain a sophisticated understanding of the material in this text, but I don't want readers to struggle with the ideas.

Second, I've taken various steps that I hope will foster an “alliance” with readers. My strategy here grows out of the fact that, like most teachers, I value the questions I receive from students and the discussions I have with them. In

the classroom, this allows a two-way flow of information that unmistakably improves the educational process. Of course, a two-way flow isn't possible in a textbook, but I've offered what I hope is a good approximation: Often, the questions I hear from students, and the discussions I have with them, focus on the relevance of the course material to students' own lives, or relevance to the world outside of academics. I've tried to capture that dynamic, and to present my answers to these student questions, in the essay at the end of each chapter (I'll say more about these essays in a moment). These essays appear under the banner **Cognitive Psychology and Education**, and—as the label suggests—the essays will help readers understand how the materials covered in that chapter matter for (and might change!) the readers' own learning. In addition, I've written a separate series of essays (available online), titled **Cognitive Psychology and the Law**, to explore how each chapter's materials matter in another arena—the enormously important domain of the justice system. I hope that both types of essays—**Education and Law**—help readers see that all of this material is indeed relevant to their lives, and perhaps as exciting for them as it is for me.

Have I met all of these goals? You, the readers, will need to be the judges of this. I would love to hear from you about what I've done well in the book and what I could have done better; what I've covered (but should have omitted) and what I've left out. I'll do my best to respond to every comment. You can reach me via email (reisberg@reed.edu); I've been delighted to get comments from readers about previous editions, and I hope for more emails with this edition.

An Outline of the Seventh Edition

The book's 14 chapters are designed to cover the major topics within cognitive psychology. The chapters in Part 1 lay the foundation. Chapter 1 provides the conceptual and historical background for the subsequent chapters. In addition, this chapter seeks to convey the extraordinary scope of the field and why, therefore, research on cognition is so important. The chapter also highlights the relationship between theory and evidence in cognitive psychology, and it discusses the logic on which this field is built.

Chapter 2 then offers a brief introduction to the study of the brain. Most of cognitive psychology is concerned with the functions that our brains make possible, and not the brain itself. Nonetheless, our understanding of cognition has certainly been enhanced by the study of the brain, and throughout this book we'll use biological evidence as one means of evaluating our theories. Chapter 2 is designed to make this evidence fully accessible to the reader—by providing a quick survey of the research tools used in studying the brain, an overview of the brain's anatomy, and also an example of how we can use brain evidence as a source of insight into cognitive phenomena.

Part 2 of the book considers the broad issue of how we gain information from the world. Chapter 3 covers visual perception. At the outset, this chapter links to the previous (neuroscience) chapter with descriptions of the eyeball and the basic mechanisms of early visual processing. In this context, the chapter introduces the crucial concept of parallel processing and the prospect of mutual influence

among separate neural mechanisms. From this base, the chapter builds toward a discussion of the perceiver's *activity* in shaping and organizing the visual world, and explores this point by discussing the rich topics of perceptual constancy and perceptual illusions.

Chapter 4 discusses how we recognize the objects that surround us. This seems a straightforward matter—what could be easier than recognizing a telephone, or a coffee cup, or the letter *Q*? As we'll see, however, recognition is surprisingly complex, and discussion of this complexity allows me to amplify key themes introduced in earlier chapters: how *active* people are in organizing and interpreting the information they receive from the world; the degree to which people *supplement* the information by relying on prior experience; and the ways in which this knowledge can be built into a *network*.

Chapter 5 then considers what it means to “pay attention.” The first half of the chapter is concerned largely with selective attention—cases in which you seek to focus on a target while ignoring distractors. The second half of the chapter is concerned with divided attention (“multi-tasking”)—that is, cases in which you seek to focus on more than one target, or more than one task, at the same time. Here, too, we'll see that seemingly simple processes turn out to be more complicated than one might suppose.

Part 3 turns to the broad topic of memory. Chapters 6, 7, and 8 start with a discussion of how information is “entered” into long-term storage, but then turn to the complex interdependence between how information is first learned and how that same information is subsequently retrieved. A recurrent theme in this section is that learning that's effective for one sort of task, one sort of use, may be quite ineffective for other uses. This theme is examined in several contexts, and leads to a discussion of research on unconscious memories—so-called memory without awareness. These chapters also offer a broad assessment of human memory: How accurate are our memories? How complete? How long-lasting? These issues are pursued both with regard to theoretical treatments of memory and also with regard to the practical consequences of memory research, including the application of this research to the assessment, in the courtroom, of eyewitness testimony.

The book's Part 4 is about knowledge. Earlier chapters show over and over that humans are, in many ways, guided in their thinking and experiences by what they already know—that is, the broad pattern of knowledge they bring to each new experience. This invites the questions posed by Chapters 9, 10, and 11: What is knowledge? How is it represented in the mind? Chapter 9 tackles the question of how “concepts,” the building blocks of our knowledge, are represented in the mind. Chapters 10 and 11 focus on two special types of knowledge. Chapter 10 examines our knowledge about language; Chapter 11 considers visual knowledge and examines what is known about mental imagery.

The chapters in Part 5 are concerned with the topic of thinking. Chapter 12 examines how each of us draws conclusions from evidence—including cases in which we are trying to be careful and deliberate in our judgments, and also cases of informal judgments of the sort we often make in our everyday lives. The chapter then turns to the question of how we reason from our beliefs—how we

check on whether our beliefs are correct, and how we draw conclusions, based on things we already believe. The chapter also considers the practical issue of how errors in thinking can be diminished through education.

Chapter 13 is also about thinking, but with a different perspective: This chapter considers some of the ways people differ from one another in their ability to solve problems, in their creativity, and in their intelligence. The chapter also addresses the often heated, often misunderstood debate about how different groups—especially American Whites and African Americans—might (or might not) differ in their intellectual capacities.

The final chapter in the book does double service. First, it pulls together many of the strands of contemporary research relevant to the topic of consciousness—what consciousness is, and what consciousness is for. In addition, most readers will reach this chapter at the end of a full semester’s work, a point at which they are well served by a review of the topics already covered and ill served by the introduction of much new material. Therefore, this chapter draws many of its themes and evidence from previous chapters, and in that fashion it serves as a review of points that appear earlier in the book. Chapter 14 also highlights the fact that we’re using these materials to approach some of the greatest questions ever asked about the mind, and, in that way, this chapter should help to convey some of the power of the material we’ve been discussing throughout the book.

New in the Seventh Edition

What’s new in this edition? Every chapter contains new material, in most cases because readers specifically requested the new content! Chapter 1, for example, now includes discussion of how the field of cognitive psychology emerged in the 1950s and 1960s. Chapter 4 includes coverage of recent work on how people differ from one another in their level of face-recognition skill. Chapter 5 discusses what it is that people pay attention to, with a quick summary of research on how men and women differ in what they focus on, and how different cultures seem to differ in what they focus on. Chapter 8 discusses a somewhat controversial and certainly dramatic study showing that college students can be led to a false memory of a time they committed a felony (an armed assault) while in high school; this chapter also now includes coverage of the social nature of remembering. Chapter 10 now discusses the topics of *prosody* and *pragmatics*. Chapter 12 discusses the important difference between “opt-in” and “opt-out” procedures for social policy, and Chapter 14 now includes discussion of (both the myths and the reality of) subliminal perception.

In this edition, I’ve also added three entirely new features. First, my students are always curious to learn how cognitive psychology research can be applied to issues and concerns that arise in everyday life. I’ve therefore added a **Cognition Outside the Lab** essay to every chapter. For example, in Chapter 4, in discussing how word recognition proceeds, I’ve tackled the question of how the choice of font can influence readers (sometimes in good ways and sometimes not). In

Chapter 7, I've written about cryptoplagiarism, a pattern in which you can steal another person's ideas without realizing it!

Second, I have always believed that, as someone teaching cognitive psychology, I need to respect the practical lessons of my field. As one example, research suggests that students' understanding and memory are improved if they pause and reflect on materials they've just heard in a lecture or just read in a book. "What did I just hear? What were the main points? Which bits were new, and which bits had I thought about before?" Guided by that research, I've added **Test Yourself** questions throughout the book. These questions are then echoed at the end of the chapter, with the aim of encouraging readers to do another round of reflection. All these questions are designed to be easy and straightforward—but should, our research tells us, be genuinely helpful for readers.

Third, the topics covered in this book have many implications, and I hope readers will find it both fun and useful to think about some of these implications. On this basis, every chapter also ends with a couple of **Think About It** questions, inviting readers to extend the chapter's lessons into new territory. For example, at the end of Chapter 3, I invite readers to think about how research on *attention* might help us understand what happens in the focused exercise of meditation (including Buddhist meditation). The question at the end of Chapter 7 invites readers to think through how we might explain the eerie sensation of *déjà vu*. A question at the end of Chapter 8 explores how your memory is worse than a video recorder, and also how it's better than a video recorder.

Other Special Features

In addition, I have (of course) held on to features that were newly added in the previous edition—including an art program that showcases the many points of contact between cognitive psychology and cognitive neuroscience, and the "**What if . . .**" section that launches each chapter. The "**What if . . .**" material serves several aims. First, the mental capacities described in each chapter (the ability to recognize objects, the ability to pay attention, and so on) are crucial for our day-to-day functioning, and to help readers understand this point, most of the "**What if . . .**" sections explore what someone's life is like if they *lack* the relevant capacity. Second, the "**What if . . .**" sections are rooted in concrete, human stories; they talk about specific individuals who lack these capacities. I hope these stories will be inviting and thought-provoking for readers, motivating them to engage the material in a richer way. And, third, most of the "**What if . . .**" sections involve people who have lost the relevant capacity through some sort of brain damage. These sections therefore provide another avenue through which to highlight the linkage between cognitive psychology and cognitive neuroscience.

This edition also includes explicit coverage of **Research Methods**. As in the previous edition, this material is covered in an appendix, so that it's easily accessible to all readers, but set to the side to accommodate readers (or instructors) who prefer to focus on the book's substantive content. The appendix is divided into separate essays for each chapter, so that the appendix can be used on a

chapter-by-chapter basis. This organization will help readers see, for each chapter, how the research described in the chapter unfolds, and it will simultaneously provide a context for each methods essay so that readers can see why the methods are so important.

The appendix is surely no substitute for a research methods course, but nonetheless it's sequenced in a manner that builds toward a broad understanding of how the scientific method plays out in our field. An early essay, for example, works through the question of what a “testable hypothesis” is, and why this is so important; another essay works through the power of random assignment; another discusses how we deal with confounds. In all cases, my hope is that the appendix will guide readers toward a sophisticated understanding of why our research is as it is, and why, therefore, our research is so persuasive.

I have already mentioned the end-of-chapter essays on **Cognitive Psychology and Education**, which show students how cognitive psychology is connected to their own learning. Readers often seek “take-home messages” from the material that will, in a direct way, benefit them. We are, after all, talking about memory, and students obviously are engaged in an endeavor of putting lots of new information—information they're learning in their courses—into their memories. We're talking about attention, and students often struggle with the chore of keeping themselves “on task” and “on target.” In light of these points, the end-of-chapter essays build a bridge between the content in the chapter and the concerns that fill students' lives. This will, I hope, make the material more useful for students, and also make it clear just how important an enterprise cognitive psychology is.

There are also essays in the ebook on **Cognitive Psychology and the Law**. Here, I've drawn on my own experience in working with law enforcement and the criminal justice system. In this work, I'm called on to help juries understand how an eyewitness might be certain in his recollection, but *mistaken*. I also work with police officers to help them elicit as much information from a witness as possible, without leading the witness in any way. Based on this experience, the online essays discuss how the material in each chapter might be useful for the legal system. These essays will, I hope, be immediately interesting for readers, and will also make it obvious why it's crucial that the science be done carefully and well—so that we bring only high-quality information into the legal system.

I've also included **Demonstrations** in the ebook to accompany the book's description of key concepts in the field. Many of these demos are miniature versions of experimental procedures, allowing students to see for themselves what these experiments involve, and also allowing them to see just how powerful many of our effects are. Readers who want to run the demos for themselves as they read along certainly can; instructors who want to run the demos within their classrooms (as I sometimes do) are certainly encouraged to do so. Instructors who want to use the demos in discussion sections, aside from the main course, can do that as well. In truth, I suspect that some demos will work better in one of these venues, and that other demos will work better in others; but, in all cases, I hope the Demonstrations help bring the material to life—putting students directly in contact with both our experimental methods and our experimental results.

As in previous editions, this version of *Cognition* also comes with various supplementary materials, some aimed at students, and some aimed at instructors.

For Students

ZAPS Cognition Labs. Every copy of the text comes packaged with free access to ZAPS Cognition Labs, an updated revision of Norton’s popular online psychology labs. Crafted specifically to support cognitive psychology courses, this version helps students learn about core psychological phenomena. Each lab (one or two per chapter) begins with a brief introduction that relates the topic to students’ lives. Students then engage in a hands-on experience that, for most labs, produces data based on their individual responses. The theories behind the concepts are then explained alongside the data the student has generated. Also, an assessment component lets students confirm that they understand the concepts central to each lab. Finally, this edition of *Cognition* is accompanied by five new ZAPS labs: Encoding Specificity, Mental Rotation 3D, Memory Span, Operation Span, and Selective Attention.

Ebook. Every print copy of the text comes packaged with free access to the ebook. The ebook can also be purchased separately at a fraction of the price of the printed version. The ebook has several advantages over the print text. First, the ebook includes *Demonstrations*—quick, pen-and-paper mini experiments—designed to show students what key experiments involve and how powerful many of the effects are. Second, the ebook includes the *Cognitive Psychology and the Law* essays, described above. In addition, the ebook can be viewed on any device—laptop, tablet, phone, public computer—and will stay synced between devices. The ebook is therefore a perfect solution for students who want to learn in more convenient settings—and pay less for doing so.

For Instructors

All instructor resources for this edition of *Cognition* can be accessed via the “Instructor Resources” tile at the following URL: <https://digital.wwnorton.com/cognition7>.

Interactive Instructor’s Guide (IIG). This online repository of teaching assets offers material for every chapter that both veteran and novice instructors of the course will find helpful. Searchable by chapter or asset class, the IIG provides multiple resources for teaching: links to online video clips (selected and annotated by the author), teaching suggestions, and other class activities and exercises. It also includes all of the Education, Law, and Research Methods essays described above, as well as discussion questions to support the Education and Law essays. The demonstrations from the ebook can also be found here. This repository of lecture and teaching materials functions both as a course prep tool and as a means of tracking the latest ideas in teaching the cognitive psychology course.

I’m especially excited about the online video clips. Students love videos and probably spend more time than they should surfing the Internet (and YouTube in particular) for fun clips. As it turns out, though, YouTube contains far more

than cute-kittens movies; it also contains intriguing, powerful material directly relevant to the topics in this text. The IIG therefore provides a listing of carefully selected online videos to accompany each of the chapters. (A dozen of these videos are newly added for the seventh edition!) The annotated list describes each clip, and gives information about timing, in ways that should make these videos easy to use in the classroom. I use them in my own teaching, and my students love them. But let me also make a request: I'm sure there are other videos available that I haven't seen yet. I'll therefore be grateful to any readers who help me broaden this set, so that we can make this resource even better.

Test Bank. The test bank features over 900 questions, including multiple-choice and short-answer questions for each chapter. I have personally vetted each question, and all questions have been updated according to Norton's assessment guidelines to make it easy for instructors to construct quizzes and exams that are meaningful and diagnostic. All questions are classified according to learning objective, text section, difficulty, and question type. This Norton test bank is available with ExamView Test Generator software, allowing instructors to create, administer, and manage assessments. The intuitive test-making wizard makes it easy to create customized exams. Other features include the ability to create paper exams with algorithmically generated variables and to export files directly to your LMS.

Lecture PowerPoints. These text-focused PowerPoints follow the chapter outlines, include figures from the text, and feature instructor-only notes.

Art Slides. All the figures, photos, and tables from the text are offered as JPEGs, both separately and embedded in a PowerPoint for each chapter. All text art is enhanced for optimal viewing when projected in large classrooms.

Coursepack (Blackboard, Canvas, Angel, Moodle, and other LMS systems). Available at no cost to professors or students, Norton coursepacks for online, hybrid, or lecture courses are available in a variety of formats. With a simple download from the instructor's website, an adopter can bring high-quality Norton digital media into a new or existing online course (no extra student passwords required), and it's theirs to keep. Instructors can edit assignments at the question level and set up custom grading policies to assess student understanding. In addition to the instructor resources listed above, the coursepack includes additional chapter quizzes, flashcards, chapter outlines, chapter summaries, all of the Education, Law, and Research Methods essays described above, and additional questions on the essays.

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Daniel Reisberg
Portland, Oregon

The Foundations of Cognitive Psychology

part
1

What is cognitive psychology? In Chapter 1, we'll define this discipline and offer a sketch of what this field can teach us—through its theories and its practical applications. We'll also provide a brief history to explain why cognitive psychology has taken the form that it has.

Chapter 2 has a different focus. At many points in this book, we'll draw insights from the field of *cognitive neuroscience*—the effort toward understanding our mental functioning through close study of the brain and nervous system. To make sure this biological evidence is useful, though, we need to provide some background, and that's the main purpose of Chapter 2. There, we'll offer a rough mapping of what's where in the brain, and we'll describe the functioning of many of the brain's parts. We'll also discuss *what it means* to describe the functioning of this or that brain region, because, as we will see, each of the brain's parts is highly specialized in what it does. As a result, mental achievements such as reading, remembering, or deciding depend on the coordinated functioning of many different brain regions, with each contributing its own small bit to the overall achievement.



chapter **1**

The Science of the Mind



Almost everything you do, and everything you feel or say, depends on your *cognition*—what you know, what you remember, and what you think. As a result, the book you’re now reading—a textbook on cognition—describes the foundation for virtually every aspect of who you are.

As illustrations of this theme, in a few pages we’ll consider the way in which your ability to cope with grief depends on how your memory functions. We’ll also discuss the role that memory plays in shaping your self-image—and, therefore, your self-esteem. As another example, we’ll discuss a case in which your understanding of a simple story depends on the background knowledge that you supply. Examples like these make it clear that cognition matters in an extraordinary range of circumstances, and it’s on this basis that our focus in this book is on the intellectual foundation of almost every aspect of human experience.

The Scope of Cognitive Psychology

When the field of cognitive psychology was first launched, it was broadly focused on the *scientific study of knowledge*, and this focus led immediately to a series of questions: How is knowledge acquired? How is knowledge retained so that it’s available when needed? How is knowledge used—whether as a basis for making decisions or as a means of solving problems?

These are great questions, and it’s easy to see that answering them might be quite useful. For example, imagine that you’re studying for next Wednesday’s exam, but for some reason the material just won’t “stick” in your memory. You find yourself wishing, therefore, for a better strategy to use in studying and memorizing. What would that strategy be? Is it possible to have a “better memory”?

As a different case, let’s say that while you’re studying, your friend is moving around in the room, and you find this quite distracting. Why can’t you just shut out your friend’s motion? Why don’t you have better control over your attention and your ability to concentrate?

Here’s one more example: You’re looking at your favorite Internet news site, and you’re horrified to learn how many people have decided to vote for candidate X. How do people decide whom to vote for? For that matter, how do people decide what college to attend, or which car to buy, or even what to have for dinner? And how can we help people make *better* decisions—so that, for example, they choose healthier foods, or vote for the candidate who (in your view) is preferable?

preview of chapter themes

- The chapter begins with a description of the *scope* of cognitive psychology. The domain of this field includes activities that are obviously “intellectual” (such as remembering, paying attention, or making judgments) but also a much broader range of activities that depend on these intellectual achievements.
- What form should a “science of the mind” take? We discuss the difficulties in trying to study the mind by means of direct observation. But we also explore why we must study the mental world if we’re to understand behavior; the reason is that our behavior depends in crucial ways on how we *perceive* and *understand* the world around us.
- Combining these themes, we come to the view that we must study the mental world *indirectly*. But as we will see, the method for doing this is the method used by most sciences.

Before we’re through, we’ll consider evidence pertinent to all of these questions. Let’s note, though, that in these examples, things aren’t going as you might have wished: You remember less than you want to; you can’t ignore a distraction; the voters make a choice you don’t like. What about the other side of the picture? What about the remarkable intellectual feats that humans achieve—brilliant deductions or creative solutions to complex problems? In this text, we’ll also discuss these cases and explore how people manage to accomplish the great things they do.



CELEBRATING HUMAN ACHIEVEMENTS

Many of the text’s examples involve *failures* or *limitations* in our cognition. But we also need to explain the incredible intellectual achievements of our species—the complex problems we’ve solved and the extraordinary devices we’ve invented.

The Broad Role for Memory

The questions we've mentioned so far might make it sound like cognitive psychology is concerned just with your functioning as an intellectual—your ability to remember, or to pay attention, or to think through options when making a choice. As we've said, though, the relevance of cognitive psychology is much broader—thanks to the fact that a huge range of your actions, thoughts, and feelings *depend on your cognition*. As one way to convey this point, let's ask: When we investigate how memory functions, what's at stake? Or, to turn this around, what aspects of your life depend on memory?

You obviously rely on memory when you're taking an exam—memory for what you learned during the term. Likewise, you rely on memory when you're at the supermarket and trying to remember the cheesecake recipe so that you can buy the right ingredients. You also rely on memory when you're reminiscing about childhood. But what else draws on memory?

Consider this simple story (adapted from Charniak, 1972):

Betsy wanted to bring Jacob a present. She shook her piggy bank. It made no sound. She went to look for her mother.

This four-sentence tale is easy to understand, but *only because you provided important bits of background*. For example, you weren't at all puzzled about why Betsy was interested in her piggy bank; you weren't puzzled, specifically, about why the story's first sentence led naturally to the second. This is because you already knew (a) that the things one gives as presents are often things bought for the occasion (rather than things already owned), (b) that buying things requires money, and (c) that money is sometimes stored in piggy banks. Without these facts, you would have wondered why a desire to give a gift would lead someone to her piggy bank. (Surely you didn't think Betsy intended to give the piggy bank itself as the present!) Likewise, you immediately understood why Betsy *shook* her piggy bank. You didn't suppose that she was shaking it in frustration or trying to find out if it would make a good percussion instrument. Instead, you understood that she was trying to determine its contents. But you knew this fact only because you already knew (d) that Betsy was a child (because few adults keep their money in piggy banks), (e) that children don't keep track of how much money is in their banks, and (f) that piggy banks are made out of opaque material (and so a child can't simply look into the bank to see what's inside). Without these facts, Betsy's shaking of the bank would make no sense. Similarly, you understood what it meant that the bank made no sound. That's because you know (g) that it's usually coins (not bills) that are kept in piggy banks, and (h) that coins make noise when they're shaken. If you didn't know these facts, you might have interpreted the bank's silence, when it was shaken, as good news, indicating perhaps that the bank was jammed full of \$20 bills—an inference that would have led you to a very different expectation for how the story would unfold from there.



A SIMPLE STORY

What is involved in your understanding of this simple story? Betsy wanted to bring Jacob a present. She shook her piggy bank. It made no sound. She went to look for her mother.



TRYING TO FOCUS

Often, you want to focus on just one thing, and you want to shut out the other sights and sounds that are making it hard for you to concentrate. What steps should you take to promote this focus and to avoid distraction?

Of course, there's nothing special about the "Betsy and Jacob" story, and we'd uncover a similar reliance on background knowledge if we explored how you understand some other narrative, or follow a conversation, or comprehend a TV show. Our suggestion, in other words, is that many (perhaps all) of your encounters with the world depend on your supplementing your experience with knowledge that you bring to the situation. And perhaps this *has* to be true. After all, if you didn't supply the relevant bits of background, then anyone telling the "Betsy and Jacob" story would need to spell out all the connections and all the assumptions. That is, the story would have to include all the facts that, *with* memory, are supplied by you. As a result, the story would have to be much longer, and the telling of it much slower. The same would be true for every story you hear, every conversation you participate in. Memory is thus crucial for each of these activities.

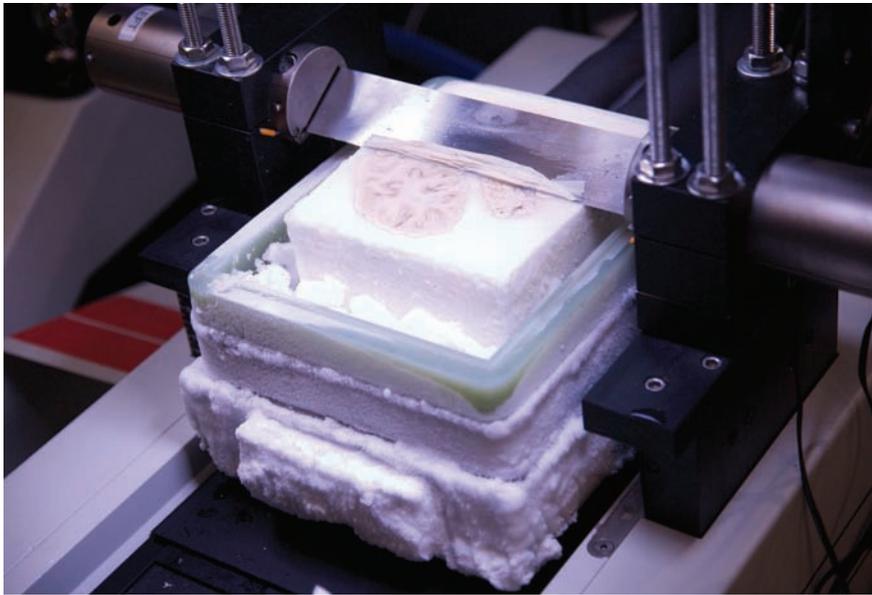
Amnesia and Memory Loss

Here is a different sort of example: In Chapter 7, we will consider cases of clinical *amnesia*—cases in which someone, because of brain damage, has lost the ability to remember certain materials. These cases are fascinating at many levels and provide key insights into what memory is *for*. Without memory, what is disrupted?

H.M. was in his mid-20s when he had brain surgery intended to control his severe epilepsy. The surgery was, in a narrow sense, a success, and H.M.'s epilepsy was brought under control. But this gain came at an enormous cost, because H.M. essentially lost the ability to form new memories. He survived for more than 50 years after the operation, and for all those years he had little trouble remembering events *prior to* the surgery. But H.M. seemed completely unable to recall any event that occurred *after* his operation. If asked who the president is, or about recent events, he reported facts and events that were current at the time of the surgery. If asked questions about last week, or even an hour ago, he recalled nothing.

This memory loss had massive consequences for H.M.'s life, and some of the consequences are surprising. For example, he had an uncle he was very fond of, and he occasionally asked his hospital visitors how his uncle was doing. Unfortunately, the uncle died sometime after H.M.'s surgery, and H.M. was told this sad news. The information came as a horrible shock, but because of his amnesia, H.M. soon forgot about it.

Sometime later, because he'd *forgotten* about his uncle's death, H.M. again asked how his uncle was doing and was again told of the death. But with no memory of having heard this news before, he was once more hearing it "for the first time," with the shock and grief every bit as strong as it was initially. Indeed, each time he heard this news, he was hearing it "for the first time." With no memory, he had no opportunity to live with the news, to adjust to it. As a result, his grief could not subside. Without memory, H.M. had no way to come to terms with his uncle's death.



H.M.'S BRAIN

When H.M. died in 2008, the world learned his full name — Henry Molaison. Throughout his life, H.M. had cooperated with researchers in many studies of his memory loss. Even after his death, H.M. is contributing to science: His brain (shown here) was frozen and has now been sliced into sections for detailed anatomical study. Unfortunately, though, there has been debate over who “owns” H.M.’s brain and how we might interpret some observations about his brain (see, for example, Dittrich, 2016).

A different glimpse of memory function comes from some of H.M.’s comments about what it felt like to be in his situation. Let’s start here with the notion that for those of us without amnesia, numerous memories support our conception of who we are: We know whether we deserve praise for our good deeds or blame for our transgressions because we remember those good deeds and transgressions. We know whether we’ve kept our promises or achieved our goals because, again, we have the relevant memories. None of this is true for people who suffer from amnesia, and H.M. sometimes commented that in important ways, he didn’t know who he was. He didn’t know if he should be proud of his accomplishments or ashamed of his crimes; he didn’t know if he’d been clever or stupid, honorable or dishonest, industrious or lazy. In a sense, then, without a memory, there is no self. (For broader discussion, see Conway & Pleydell-Pearce, 2000; Hilts, 1995.)

What, then, is the scope of cognitive psychology? As we mentioned earlier, this field is sometimes defined as the scientific study of the acquisition, retention, and use of knowledge. We’ve now seen, though, that “knowledge” (and hence the study of how we gain and use knowledge) is relevant to a huge range of concerns. Our self-concept, it seems, depends on our knowledge (and, in particular, on our memory for various episodes in our past). Our

TEST YOURSELF

1. Why is memory crucial for behaviors and mental operations that don't in any direct or explicit way ask you "to remember"?
2. What aspects of H.M.'s life were disrupted as a result of his amnesia?

emotional adjustments to the world rely on our memories. Even our ability to understand a simple story—or, presumably, our ability to understand any experience—depends on our supplementing that experience with some knowledge.

The suggestion, then, is that cognitive psychology can help us understand capacities relevant to virtually every moment of our lives. Activities that don't appear to be intellectual would collapse without the support of our cognitive functioning. The same is true whether we're considering our physical movements through the world, our social lives, our emotions, or any other domain. This is the scope of cognitive psychology and, in a real sense, the scope of this book.

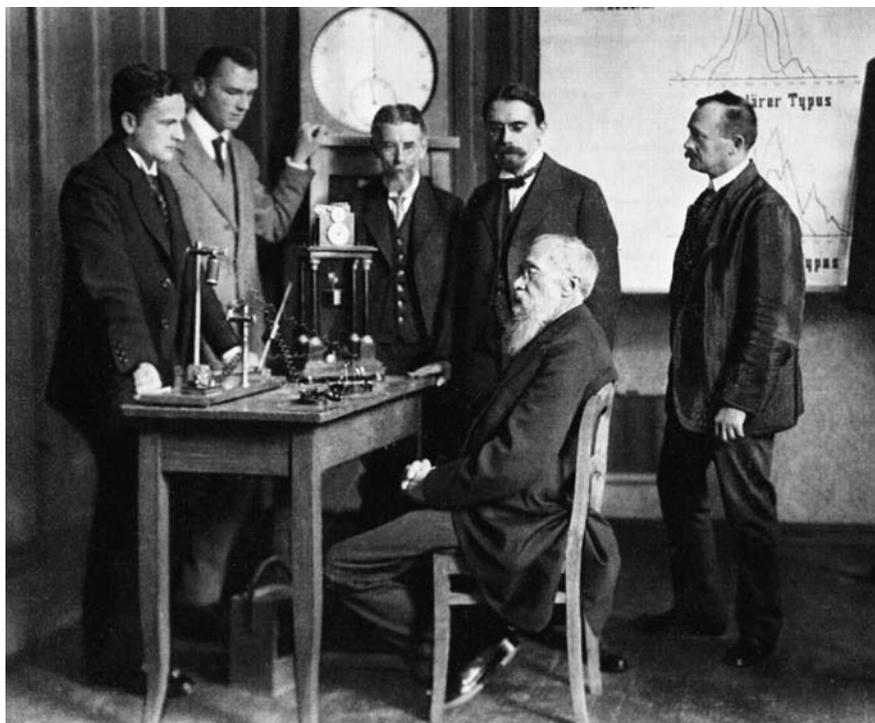
The Cognitive Revolution

The enterprise that we now call “cognitive psychology” is a bit more than 50 years old, and the emergence of this field was in some ways dramatic. Indeed, the science of psychology went through a succession of changes in the 1950s and 1960s that are often referred to as psychology's “cognitive revolution.” This “revolution” involved a new style of research, aimed initially at questions we've already met: questions about memory, decision making, and so on. But this new type of research, and its new approach to theorizing, soon influenced other domains, with the result that the cognitive revolution dramatically changed the intellectual map of our field.

The cognitive revolution centered on two key ideas. One idea is that the science of psychology cannot study the mental world directly. A second idea is that the science of psychology *must* study the mental world if we're going to understand behavior. As a path toward understanding these ideas, let's look at two earlier traditions in psychology that offered a rather different perspective. Let's emphasize, though, that our purpose here is not to describe the full history of modern cognitive psychology. That history is rich and interesting, but our goal is a narrow one—to explain why the cognitive revolution's themes were as they were. (For readers interested in the history, see Bartlett, 1932; Benjamin, 2008; Broadbent, 1958; Malone, 2009; Mandler, 2011.)

The Limits of Introspection

In the late 19th century, Wilhelm Wundt (1832–1920) and his student Edward Bradford Titchener (1867–1927) launched a new research enterprise, and according to many scholars it was their work that eventually led to the modern field of experimental psychology. In Wundt's and Titchener's view, psychology needed to focus largely on the study of conscious mental events—feelings, thoughts, perceptions, and recollections. But how should these events be studied? These early researchers started with the fact that there is no way for you to experience my thoughts, or I yours. The only person who can experience or observe your thoughts is you. Wundt, Titchener, and their colleagues



WILHELM WUNDT

Wilhelm Wundt (1832–1920) is shown here sitting and surrounded by his colleagues and students. Wundt is often regarded as the “father of experimental psychology.”

concluded, therefore, that the only way to study thoughts is through **introspection**, or “looking within,” to observe and record the content of our own mental lives and the sequence of our own experiences.

Wundt and Titchener insisted, though, that this introspection could not be casual. Instead, introspectors had to be meticulously trained: They were given a vocabulary to describe what they observed; they were taught to be as careful and as complete as possible; and above all, they were trained simply to report on their experiences, with a minimum of interpretation.

This style of research was enormously influential for several years, but psychologists gradually became disenchanted with it, and it’s easy to see why. As one concern, these investigators soon had to acknowledge that some thoughts are *unconscious*, which meant that introspection was limited as a research tool. After all, by its very nature introspection is the study of conscious experiences, so of course it can tell us nothing about unconscious events.

Indeed, we now know that unconscious thought plays a huge part in our mental lives. For example, what is your middle name? Most likely, the moment you read this question, the name “popped” into your thoughts without any effort. But, in fact, there’s good reason to think that this simple bit of remembering requires a complex series of steps. These steps take place outside of awareness; and so, if we rely on introspection as our means of studying mental events, we have no way of examining these processes.