

International Student Edition



COGNITION

EXPLORING THE SCIENCE OF THE MIND

DANIEL REISBERG

Fourth Edition

NOT FOR SALE IN THE UNITED STATES OR CANADA

FOURTH EDITION

COGNITION

Exploring the Science of the Mind



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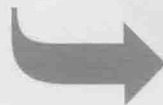
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1

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Signal Detection Theory
Duration: 15 minutes

Introduction

It could happen to any one of us: you're standing at the cash register when an armed stranger enters the store. He orders the cashier to open the register, the robber grabs the money and runs out the door before the cashier can call for help. The next day, the police call to inform you that they have the chief witnesses to the robbery, can identify the suspect? You have the difficult task of determining whether the suspect is the correct offender. The fact that the suspect is in prison makes this task even more difficult.

Further info

In the following, you can discover how difficult it often is to identify a non-signal (the suspect is absent)...

2

An **Experiment** allows students to experience psychological phenomena in the role of subject or researcher. Where appropriate, a Data section with a detailed breakdown of results follows the experiment. Instructors can collect aggregate class data.

Signal Detection Results

		Response	
		yes	no
Signal present	Hits	0,45	0,55
	False Alarms	0,55	0,45
Signal absent	Correct Rejections	0,45	0,55
	Misses	0,55	0,45

3

A **Theory** section allows students to read about the theoretical basis behind each experiment after completion.

Signal Detection Theory
Duration: 15 minutes

Theory

You have just had the responsibility of detecting when the suspect was absent. As seen in the results shown below, you made a number of errors.

- The suspect is present in the lineup and you did not detect him. This is known as a **miss**.
- The suspect is absent in the lineup and you gave a response. In that case, you again make a **correct negative**.
- The suspect is present in the lineup, but you did not detect him. What happens here is that an offender is known as a **miss**.
- The last possibility is that the suspect is absent in the lineup and you give a response. This means that you have **falsely accused** someone.

4

A **Further Info** section offers students additional real-world examples or discussion of similar phenomena.

Signal Detection Theory
Duration: 15 minutes

Further info

The number of hits, correct rejections, misses, and false alarms is influenced by the expected outcomes of the task. A very cautious person may be predisposed to give many false alarms, resulting in high rates of misses. Interestingly, response patterns can be manipulated by linking differential rewards or punishment. The tables below illustrate this principle.

A	Response: Suspect	Response: Not Suspect

See more at wwnorton.com/zaps.

FOURTH EDITION

COGNITION

For Friderike

Preface

I was a college sophomore when I took my first course in cognitive psychology. I was excited about the course then, and I've been excited about the field ever since. Why? First, cognitive psychologists are asking terrific questions. Some of the questions concern broad issues 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 are of a more immediate, personal, concern: 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 the radio 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 the second reason I find cognitive psychology so exciting. In the last half-century, 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 something 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 courts. 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 excited about the connections that cognitive psychology makes possible. In the modern academic world, intellectual disciplines are often isolated from each other, 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 will touch on topics in philosophy, economics, biology, linguistics, politics, computer science, and medicine. These connections bring obvious benefits, since insights and information can

be traded back and forth between the domains. In addition, these connections highlight the importance of the material we will be examining, since these 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 are working on questions of considerable power and scope.

I have tried in this text to convey all this excitement. I've done my best to describe the questions being asked within my field, and 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 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 findings, and the theoretical framework that holds all of these pieces together. I've tried to find the same balance in this text.

In addition, I try throughout this book to “tell a good story,” one that conveys how the various pieces of our field fit together into a coherent package. As part of this effort, I've emphasized the flow of ideas—how new theories lead to new experiments, and how those experiments can lead to new theory. I've also emphasized the ways in which different forms of evidence weave together—so that, for example, the coverage of neuroscience is not just used to tell students which brain areas seem associated with which function; instead, the neuroscience is used to address the psychological questions that have long been of interest to the field.

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 5.) With an eye on this point, I've therefore made sure to highlight the interconnections among various topics, so that students can appreciate the beauty of our field, and can also be helped, in their learning, by the orderly nature of our theorizing.

I've also worked hard to help students in two other ways. First, I've tried throughout the book to make sure the prose is approachable. I want students to gain a sophisticated understanding of the material in this text, but I certainly don't want students to struggle with the ideas. Therefore, I've kept the presentation as straightforward as possible, and have attempted to keep the presentation focused for students by highlighting the main themes that bind our field together. This edition is

streamlined for increased clarity, and we've also added more illustrations to facilitate student understanding.

Second, I have, in this edition, taken several steps to form a stronger “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, which unmistakably improves the educational process. Of course, this two-way flow is not possible in a textbook, but I've offered what I think is a good approximation: Often, the questions I hear from students, and the discussions I have with them, focus on the relevance of the material we're covering—relevance to students' own lives, or relevance to the world outside of academics. In this edition, I've tried to present my answers to these student questions, and to re-create the discussions, in *The Cognition Workbook* (and I'll say more about the *Workbook* in a moment). I hope in this way to make sure that students see that the material is relevant to their lives—and perhaps also as exciting for them as it is for me.

Have I met all of these goals? You, the readers, will need to be the judge of this. I would love to hear from you about what I have 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 regular mail (at Reed College) or via e-mail (reisberg@reed.edu).

The book's fifteen chapters are designed to cover the major topics within cognitive psychology. The first section of this book lays 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 this field and why, therefore, research on cognition is so important. This chapter also highlights the relationship between theory and evidence in cognitive psychology, and 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 will use biological evidence as one means of evaluating our theories. (Indeed, one of the trends across this book's various editions has been an increased presentation of the relevant neuroscience.) 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.

In the second section of the book, we consider the problems of object recognition, and then the problem of attention. Chapter 3 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 will see, however,

recognition is surprisingly complex. Chapter 4 then considers what it means to “pay attention.” The first half of the chapter is concerned largely with selective attention, in which one seeks to focus on a target while ignoring distractors. The second half of the chapter is concerned with divided attention, in which one seeks to focus on more than one target, or more than one task, at the same time. Here, too, we will see that seemingly simple processes often turn out to be more complicated than one might suppose.

The third section turns to the broad problem of memory. Chapters 5, 6, and 7 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 is 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 current 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 the practical consequences of memory research, including the application of this research to the assessment, in the courtroom, of eyewitness testimony.

The book’s fourth section is about knowledge. Earlier chapters showed over and over that humans are, in many ways, guided in their thinking and experiences by what they already know—i.e., the broad pattern of knowledge they bring into each new experience. This invites the questions posed by Chapters 8, 9, 10, and 11: What is knowledge? How is it represented in the mind? Chapter 8 examines the idea that knowledge can be represented via a complex network, and includes a discussion of associative networks in general and connectionist modeling in particular. Chapter 9 turns to 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, with discussion both of *linguistic competence* and *linguistic performance*. Chapter 11 considers *visual knowledge* and examines what is known about mental imagery.

The chapters in the fifth section 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. Chapter 13 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. Both of these chapters examine the strategies that guide our thinking, and some of the ways that these strategies can, on occasion, lead to error. The chapters then turn to the pragmatic issue of how these errors can be diminished through education. Chapter 13 also discusses how we make decisions and choices, with a special focus first on “economic” theories of decision-making, and then on some of the seeming

“irrationality” in human decision-making. Next, Chapter 14 considers how we solve problems. The first half of the chapter discusses problem-solving strategies of a general sort, useful for all problems; the chapter then turns to more specialized strategies, and with this, the topic of expertise. The chapter concludes with a discussion of the role of creativity and insight within problem solving.

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 students will reach this chapter at the end of a full semester’s work, a point at which students are well served by a review of the topics already covered, and also a point at which students are ill served by the introduction of much new material. Therefore, this chapter draws most of its themes and evidence from previous chapters, and in that fashion serves as a review for many points that appear earlier in the book. By the same token, Chapter 15 highlights the fact that we are 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 have been discussing throughout the book.

This basic structure of the book is the same as it was in the previous editions. But much has changed in this edition. I have, of course, updated all chapters, to include important new research. In particular, I’ve expanded the neuroscience coverage in many areas. As just one example, I’ve now said much more about the neuroimaging data that help us understand the contrast between *familiarity* and *source memory*. (These two forms of memory are established by different mechanisms, each served by its own brain sites; and then are used via different processes, each involving its own sites.) Other examples are scattered throughout the entire text.

Also new for this edition is an element already mentioned: *The Cognition Workbook*. It’s common these days for textbooks to come with supplementary materials, and, in most cases, these are written by people other than the book’s author. For my book, however, I wanted supplements that were fully integrated with the text, truly emphasizing themes that were already in the book, but also carefully picking up on points that the text hadn’t covered. In addition, any textbook is, in a way, a very personal endeavor—it is a particular author’s view of the field—and I’ve always found it jarring when a text’s supplementary materials took a perspective, or offered a view, that didn’t line up well with the emphasis of the text itself.

It’s for all of these reasons that I wanted to write the workbook myself, to make sure that you, the reader, got the best ancillary materials I could arrange, and also to make sure that you got ancillary materials that were completely in tune with the goals, themes, and emphases of the main text. The workbook includes two types of materials: First, in my own classroom, I include many demonstrations—usually miniature versions of experimental procedures—so that students can see for themselves what these experiments involve, and can also see just how powerful many of our

effects are. The workbook contains adaptations of these classroom demonstrations, designed so that they can be used in whatever fashion an instructor (or the reader) wishes: 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 do) are certainly encouraged to do so. Instructors who want to use the demonstrations 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 demos help bring the material to life—putting students directly in contact both with our experimental methods and our experimental results.

Second, in my own course, I often want to go beyond the information in the text itself. Part of this “going beyond” involves an emphasis on research methods, and so I’ve included, in the workbook, an essay for each chapter that explores key principles involved in our research. One 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 these essays will guide students toward a sophisticated understanding of why our research is as it is, and why, therefore, our research is so persuasive. In addition, each of the essays ends with a discussion question, so that students can think about, and *apply*, the issues being considered. (For instructors’ and teaching assistants’ use, I’ve also written guidelines for how a class might explore these discussion questions. This material is included with the online Test Bank.)

My own students are also eager to know how the material we’re studying *matters*—for their own lives, or for the broader world. To help them think about this issue, I often draw on my own experience in working with law enforcement and the criminal justice system. In my work, I’m sometimes called on to help juries understand how an eyewitness might be certain in his recollection, but *mistaken*. I also sometimes work with police officers, to help them determine how to draw as much information from a witness as possible, without leading the witness in any way. Based on this experience, each chapter of the workbook also includes an essay that discusses how the material in that chapter might be useful for the legal system. This essay will, I hope, be immediately interesting for students, and will persuade them that the material they’re studying has important real-world consequences. In turn, it’s my hope that this will make it obvious to students why it’s crucial that the science be done carefully and well—so that we bring only high-quality information into the legal system. And for these essays, too, I’ve written discussion questions (for students’, instructors’, or TAs’ use), to help students think about these materials, and to explore the implications of what they’re studying.

In addition, my students 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—in-

formation 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 of contact, I've written an essay for each chapter designed to build the bridge between the course materials and the concerns that often 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!

Finally, let me turn to the happiest of chores—thanking all of those who have contributed to this book. I begin with those who helped with the previous editions: Bob Crowder (Yale University) and Bob Logie (University of Aberdeen) both read the entire text of the first edition, and the book was unmistakably improved by their insights. Other colleagues read, and helped me enormously with, specific chapters: Enriqueta Canseco-Gonzalez (Reed College); Rich Carlson (Pennsylvania State University); Henry Gleitman (University of Pennsylvania); Lila Gleitman (University of Pennsylvania); Peter Graf (University of British Columbia); John Henderson (Michigan State University); Jim Hoffman (University of Delaware); Frank Keil (Cornell University); Mike McCloskey (John Hopkins University); Hal Pashler (UCSD); Steve Pinker (MIT); and Paul Rozin (University of Pennsylvania).

The second edition was markedly strengthened by the input and commentary provided by these colleagues: Martin Conway (University of Bristol); Kathleen Eberhard (Notre Dame University); Howard Egeth (Johns Hopkins University); Bill Gehring (University of Michigan); Steve Palmer (University of California, Berkeley); Henry Roediger (Washington University); and Eldar Shafir (Princeton University).

In the third edition, I was again fortunate to have the advice, criticism, and insights provided by a number of colleagues who, together, have made the book better than it otherwise could have been, and I'd like to thank: Rich Carlson (Penn State); Richard Catrambone (Georgia Tech); Randall Engle (Georgia Tech); Bill Gehring and Ellen Hamilton (University of Michigan); Nancy Kim (Rochester Institute of Technology); Steve Luck (University of Iowa); Michael Miller (University of California, Santa Barbara); Evan Palmer, Melinda Kunar, and Jeremy Wolfe (Harvard University); Chris Shunn (University of Pittsburgh); and Daniel Simons (University of Illinois).

A number of colleagues also provided their insights and counsel for the fourth edition—either for the textbook itself or for *The Cognition Workbook*. I'm therefore delighted to thank: Ed Awh (University of Oregon); Glen Bodner (University of Calgary); William Gehring (University of Michigan); Katherine Gibbs (University of California, Davis); Eliot Hazeltine (University of Iowa); William Hockley (Wilfrid Laurier University); James Hoffman (University of Delaware); Helene Intraub (University of Delaware); Vikram Jaswal (University of Virginia); Karsten Loepelmann (University of Alberta); Penny Pexman (University of Calgary); and Christy Porter (College of William and Mary).

I also want to thank the people at Norton. Jon Durbin and I worked together for a dozen years, on many books, and built a bond of trust, respect, and good will that was an enormous resource for me. Jon has now moved to another corner of Norton's operations, and he'll be missed. I'm delighted, though, to be working with Jon's replacement, Sheri Snavelly, whose energy and activity as an editor, even in the earliest stages of our collaboration, have already been of immense value. Also Rebecca Homiski, Ben Reynolds, and Wamiq Jawaid have done a fabulous job of keeping the production on track, on schedule, and of the highest quality. And Alice Vigliani continues to be a wonderful copyeditor, and I hope her peonies flourish forever.

Finally, it is Jacob, Solomon, and Friderike who make this all worthwhile. They forgive me the endless hours at the computer, but also (thank heavens) tug me away from the computer at the right moments. They remind me of what is important, and also keep my life on track. I couldn't do any of this without them.

Daniel Reisberg
Portland, Oregon

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COGNITION

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