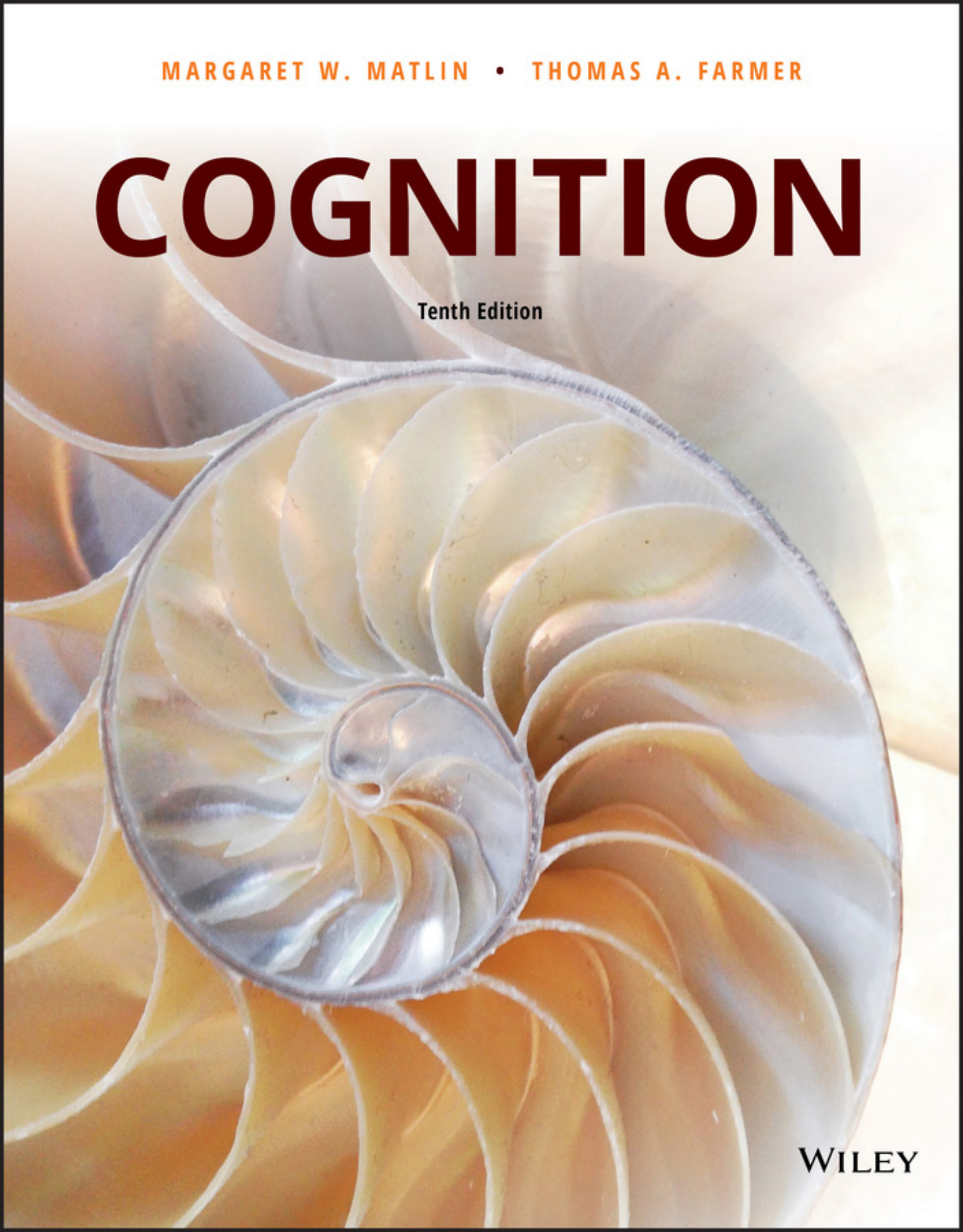


MARGARET W. MATLIN • THOMAS A. FARMER

COGNITION

Tenth Edition

WILEY



COGNITION

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TENTH
EDITION

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PREFACE

The 1st edition of this textbook was published in 1983, and was followed by eight more editions published over the course of roughly three decades. Margaret W. Matlin was the sole author of the 1st through 8th editions. After 30 years of dedication to this and other textbooks, Margaret has retired from the textbook writing enterprise. In the wake of her retirement, Thomas A. Farmer, Lecturer in Psychology at California State University—Fullerton, was contracted by Wiley to carry out the revision and updating process starting with the 9th edition of the textbook (2015). Margaret Matlin and Thomas Farmer thus share authorship for this 10th edition of *Cognition*.

Message from Author Thomas Farmer

I took Cognitive Psychology during the Spring Semester, 1999, as an undergraduate Psychology major at James Madison University in Harrisonburg, Virginia. Margaret Matlin's *Cognition* was the assigned textbook, and at that point in time, it was in its 4th edition. I remember the textbook as engaging, thought provoking, and highly accessible. In hindsight, I think that *Cognition* helped ignite my interests in topics related to the mind–body–environment relationship, and certainly contributed to my decision to pursue research opportunities in the cognitive sciences. I am thus immensely grateful for the opportunity to carry this textbook into its 10th edition.

The revisions and updates that I instituted in this edition of *Cognition* are additive in nature. For the most part, I did not remove discussions of key concepts, debates, theoretical topics, or methodological considerations. Instead, I supplemented the existing text with additional explanation, examples, and up-to-date citations. I expanded more heavily in certain places, aiming to provide readers with an overview of both classical and more contemporary treatments of a concept or theoretical framework. Additionally, I have increased the number of experiments discussed, the amount of detail embedded in their discussion, and have made a concerted effort to highlight basic components of experimental design and behavioral testing methodologies. My hope is that these additions will facilitate a greater appreciation for the rigorous experimental research so characteristic of the field. I think that these additions will aid students in the development of their ability to critically assess links between experimental design and the conclusions drawn from their results.

In the preface to the 8th edition of *Cognition*, Margaret noted that the field of cognitive psychology has changed in many ways over the past decade. She then discussed three of these changes: (1) an increase in reliance on neuroscience and neuroscientific testing methods in the scientific study of human cognition, (2) an increase in the interdisciplinary nature of research on cognitive processes, and (3) a sharp increase in the application of research in the cognitive sciences to real-world problems. I strongly agree with her observations, and have continued her mission to integrate these recent advances into this textbook. Indeed, cognitive neuroscience, interdisciplinary collaboration, and real-world application were three of the factors that motivated my decisions about how to revise and update material in this edition of the book.

In her textbooks, Margaret repeatedly demonstrates a keen ability to provide comprehensive treatments of complex research topics while writing in a style that makes them understandable to a wide range of undergraduate audiences. Although I could never perfectly mirror Margaret's elegant writing style, I tried my best to imitate it. Thus, I strived to maintain the clarity and accessibility so characteristic of Margaret's work.

In the remainder of this preface, I (1) provide an overview of the more substantial content-based additions to this edition, (2) highlight the features and organization of the book, and (3) acknowledge the many individuals who have contributed to this and previous editions.

Content-Based Additions to the 10th Edition

As noted above, very few topics were eliminated in my updating and revision of this textbook. Instead, most content-based revisions and updates involve the addition of information detailing more recent conceptualizations of key concepts and principles. Some of the more substantial changes include the following:

Chapter 1 now includes a discussion of the magnetoencephalography (MEG) cognitive neuroscientific testing method, along with a more comprehensive historical overview of individuals who have contributed to the emergence of the field of experimental psychology.

Chapter 2 includes an enhanced explanation of the speech recognition process and an extended discussion of deficits in face recognition (prosopagnosia).

Chapter 3 includes an updated discussion of research involving the Stroop task.

Chapter 4 was modified to include a more in-depth overview of the manner in which individual differences in working-memory capacity map onto variability in performance on an array of cognitive tasks. Additionally, the section on working-memory abilities in clinical populations has been extended to include a discussion of the relationship between working memory and generalized anxiety disorder (GAD).

Chapter 5 now details recent research on the effects of different amnesias on cognitive processing, as well as an extended discussion of expertise effects.

Chapter 6 now includes a discussion of test anxiety.

Chapter 7 now discusses research on individual differences in cognitive style, and provides a corresponding overview of cognitive neuroscientific research supporting these style differences.

Chapter 8 contains an updated overview of research involving the implicit attitude test, along with a discussion of more recent methodological extensions of the paradigm.

Chapter 9 includes the reintroduction of “good enough processing,” along with a more integrative discussion of the cognitive neuroscience of language.

Chapter 10 now provides an overview of research supporting a compelling role for gesture in learning, as well as a more up-to-date overview of controversy regarding the bilingual advantage.

Chapters 11 and 12 contain updated references to the classical problem solving and decision-making effects detailed in these chapters, along with a discussion of more recent research involving these effects.

Chapter 13 continues to provide an overview of research on lifespan developmental questions as they pertain to memory, language, and metacognitive abilities.

Features of This Textbook

I genuinely believe that cognitive psychology can have practical applications that stretch far beyond the classroom. Therefore, students must be able to understand and remember the material. Here are some of the ways in which I consider this textbook to be student-oriented:

1. The writing style is clear and interesting, with frequent examples to make the information more concrete. Indeed, over the years, Margaret has received letters and comments from hundreds of students and professors expressing enthusiasm for the accessibility and clarity of the writing. This edition of the textbook has been line-edited in order to ensure precision and clarity.
2. The text demonstrates how our cognitive processes are relevant in our everyday, real-world experiences.
3. The book frequently examines how cognition can be applied to other disciplines, such as clinical psychology, social psychology, consumer psychology, education, communication, business, medicine, and law.
4. The 1st chapter introduces five major themes that are repeatedly emphasized throughout the book. Because the current research in cognitive psychology is so extensive, students need a sense of continuity that helps them appreciate the connections among many diverse topics.
5. An outline appears before each chapter, providing a helpful framework for understanding the new material.
6. Each new term is presented in **boldface print**. Every term is also accompanied by a concise definition that appears in the same sentence. In addition, pronunciation guides are provided for new

terms with potentially ambiguous pronunciation. If students are hesitant about pronouncing terms such as *schema* and *saccadic*, they will be reluctant to use these words or ask questions about them.

7. Many easy-to-perform demonstrations illustrate important research in cognition, and they clarify central concepts in the discipline. These demonstrations were designed so that they would require equipment that undergraduate students typically have on hand.
8. Each chapter concludes with point-by-point summaries for each section of a chapter, followed by comprehensive review questions and a list of new terms. These features provide students with additional opportunities to review material and to identify knowledge gaps.
9. Each chapter concludes with a list of recommended readings, along with a brief description of each resource. This feature should be useful if students are searching for a topic for a literature-review paper. Furthermore, professors can consult these resources when they want to update a specific lecture.
10. A glossary at the end of the book provides a definition of every keyword. I tried to include additional contextual information wherever it might be useful, in order to clarify the terms as much as possible. For example, the word *antecedent* can be used in many contexts. Accordingly, my definition for *antecedent* begins with the phrase, “In conditional reasoning. ...”
11. The subject index is comprehensive and detailed. Students can quickly locate the keywords, because they appear in boldface.

The Textbook’s Organization

A textbook needs to be interesting and helpful. It must also reflect current developments in the discipline, and it should allow instructors to adapt its structure to their own teaching plans. The following features should therefore be useful for professors:

1. The tenth edition of *Cognition* offers a comprehensive overview of the field, including chapters on perceptual processes, memory, imagery, general knowledge, language, problem solving and creativity, reasoning and decision making, and cognitive development.
2. Each chapter is a self-contained unit. For example, terms such as *heuristics*, *schema*, and *top-down processing* are defined in every chapter where they are used. This feature allows professors considerable flexibility in the sequence of chapter coverage. Some professors may wish to discuss the topic of imagery (Chapter 7) prior to the three chapters on memory. Others might want to assign the chapter on general knowledge (Chapter 8) during an earlier part of the academic term.
3. Each section within a chapter can stand as a discrete unit, especially because every section concludes with a section summary. Professors may choose to discuss the individual sections in a different order. For example, one professor may want students to read the section on schemas prior to the chapter on long-term memory. Another professor might prefer to subdivide Chapter 13, on cognitive development, so that the 1st section of this chapter (on memory) follows Chapter 5, the 2nd section (on metacognition) follows Chapter 6, and the 3rd section (on language) follows Chapter 10. In summary, these separate sections provide professors with additional flexibility.
4. In previous editions, Margaret went to great lengths to emphasize the importance of individual differences in the study of cognitive processes. I carry on this tradition by exploring individual differences in each cognitive process discussed in this book. I take great care to emphasize to the reader how an individual difference effect can further inform our understanding of a process as it relates to theories of cognition, as well as to other clinical and social issues.
5. In all, the bibliography contains over 2,000 references, over half of which have been published since the year 2005. As a result, the textbook provides a current overview of cognitive psychology.
6. **TEST BANK:** Professors who teach courses in cognitive psychology consistently emphasize the importance of a high-quality Test Bank. The multiple-choice questions must be clear and unambiguous, and they must not focus on relatively trivial details. Most of the questions should be conceptually rich, rather than requiring brief, obvious answers. Furthermore, each chapter in

the Test Bank should contain a large number of questions, so that professors can select a different sample every time they create an examination. The Test-Bank questions available here to instructors emphasize conceptual knowledge, as well as applications to real-world situations. Furthermore, I have rated each question as “easy,” “moderate,” and “difficult.” These difficulty ratings can help professors to create a test that is appropriate for the students in their classes.

For more information, professors should contact their Wiley sales representative about the Test Bank for the tenth edition of *Cognition*. They can also visit the Wiley website for this book, www.wiley.com/college/matlin.

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In the 8th edition of *Cognition*, Margaret concluded the preface with the following words of thanks to members of her family. I conclude by carrying them over to the preface of *Cognition*, 10th edition:

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An Introduction to Cognitive Psychology

1

Chapter Introduction

What Is Cognitive Psychology?

Historical Perspective on the Field

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Chapter Introduction

Cognitive psychology is a subdiscipline of experimental psychology focused on investigating the mental processes that give rise to our perceptions and interpretations of the world around us.

In this chapter, we first explore a definition of cognition before walking through an example designed to provide clarity regarding the topics covered in the remainder of this textbook. We then examine a handful of historical developments that contributed to the emergence of cognitive psychology as a coherent subdiscipline of experimental psychology. Indeed, understanding the historical events that occurred prior to the emergence of cognitive psychology will help you appreciate how a cognitive approach differs from other approaches. In the third section of this chapter, we review contributions from multiple fields outside of psychology that have served as the basis for recent spikes in our current understanding of how the mind works. As you can imagine, recent advances in the field of neuroscience have had an immeasurable effect on our current understanding of how neural systems support mental processes.

We conclude this chapter with an overview of the general themes that you will encounter time and time again throughout this textbook. Additionally, we detail the large number of learning features that are built into this textbook. Their design is based on research in areas of cognitive psychology, such as human memory, and will help you to maximize the amount of information that you maintain as you read.

What Is Cognitive Psychology?

The term **cognition**, or mental activity, refers to the acquisition, storage, transformation, and use of knowledge. Although many have argued that nonhuman animals also have cognitive abilities, our focus here is on the inner workings of the human mind. You will likely have the opportunity to learn more about nonhuman animal cognition in other courses offered by the Psychology and Biology departments at your university.

Cognition is inescapable. At any point that you are awake, your cognitive processes are at work. They grant you the ability to recognize and interpret stimuli in your environment and to act (or react) strategically to environmental input. Cognitive processes afford you the ability to plan, to create, to interact with others, and to process all of the thoughts, sensations, and emotions that you experience on a daily basis. Your cognitive abilities operate together in intricate and highly coordinated ways to create your conscious experiences.

While reading this paragraph, for example, you are performing multiple cognitive tasks at the same time. In order to reach this paragraph, you used pattern recognition to create words from an assortment of squiggles and lines that form the letters on this page. You also consulted your memory and your knowledge about language to search for word meanings and to link together the ideas in this paragraph. Additionally, right now, as you think about these cognitive tasks, you are engaging in another cognitive task called *metacognition*—you were thinking about your own thought processes. Perhaps you made an inference such as, “This book may help me learn to study more effectively.” You may have also used decision making by saying to yourself, for instance, “I’ll finish this section of the book before I eat lunch.”

If cognition operates every time you acquire some information, place it in storage, transform that information, and use it...then cognition includes a wide range of mental processes! This textbook will explore many of these mental processes, such as perception, memory, imagery, language, problem solving, reasoning, and decision making.

Cognitive psychology has two meanings: (1) Sometimes it is a synonym for the word *cognition*; (2) Sometimes it refers to a particular theoretical approach to psychology. Specifically, the **cognitive approach** is a theoretical orientation that emphasizes people’s thought processes and their knowledge. For example, a cognitive explanation of ethnic stereotypes would emphasize topics such as the influence of these stereotypes on the judgments we make about people from different ethnic groups (Whitley & Kite, 2010).

I took Introduction to Cognitive Psychology during my junior year of college. I remember quite vividly that I had enrolled for the course because it was required, but I honestly had no idea what the term “cognitive psychology” meant. Even after our brief discussion of a definition of cognition, some of you may still not have a strong sense of what a cognitive psychologist really studies. Below, I offer a brief demonstration that should help you gain a stronger sense of what you’re in store for over the course of the semester.

Open up a Web browser, pull up a recent episode of a television show or a random video clip, and do the following: 1) Watch one minute of the video; 2) Exit your Web browser; and 3) In only two minutes, write down (or type) everything that you experienced as you watched the TV or video clip. Go ahead...give it a shot. It will only take you a total of three minutes.

I just completed the demonstration myself. I went online and selected a random music video, and I watched one minute of it. Here’s what I was able to type in two minutes after closing the Web browser:

- There was a strong bass line.
- I have never heard this song before.
- Approximately 20 people were standing close together. Music was playing but no one was moving.
- One person at the center of the group of people was female, and she was wearing a turquoise dress that looked kind of fancy.
- The camera moved from left to right but remained focused on the 20 or so people standing in a group.
- Somebody coughed in the next room (not in the video, but in the room next to where I’m sitting and watching this video).
- A female voice started to sing. She’s singing in a language that I don’t know. It sounds like it could be Swedish, but I don’t know.

Most of you were probably able to generate a list of bullet points. Now focus on the list and think about everything that you had to do in order to produce it. Or, if you didn't really complete the exercise yourself, think about all of the types of processes that I had to complete in order to produce the list above.

Importantly, I had to create a rich internal interpretation of the video in order to have a meaningful, conscious *experience* of it. In order to do so, I had to process auditory information (the music), linguistic information (the lyrics, although I couldn't really understand them), and visual information (the visual images that accompanied the music in the video).

I also had to rely heavily on information that is stored in my memory as a guide for how to interpret the auditory and visual streams of information I encountered while watching the video. Many of you are likely to be in your early 20s. That means that you have had approximately 20 years of experience with the world around you. Based on that experience, you've come to possess *knowledge* about facts (such as, "Brooklyn is one of the five boroughs of New York City"), and about patterns that are embedded in environmental stimuli (for example, the word "the" rarely comes before a verb). Crucially, notice how important this stored knowledge is for your ability to interpret and understand the video you watched. In the case of my video, I had to know which features of a person are characteristic of males versus females. If I lacked this knowledge, I would not have been able to list the 4th bullet point above. I also wouldn't have been able to note that a female voice was singing (as per the 7th bullet point above). Linking the physical characteristics of the auditory and visual streams you processed to knowledge stored in your memory was thus necessary for you to create a meaningful interpretation of the video.

Attentional processes also contributed to my interpretation, and thus experience, of the video. Do you think that I remembered every detail of the video well enough to be able to precisely describe it? Probably not. I had to perceive and interpret information from the environment (the video) on a very fast timescale. Under such time pressure, I had to strategically allocate my attention to elements and events occurring in the video that seemed most relevant and important. I also noted that I heard someone in a room next to me cough. This cough had nothing to do with the video I was watching, and yet I still processed it (enough to report my perception of the cough after the video was complete . . . it was part of my experience watching the video).

And, in order to type the list of bullet points, I had to access my stored memories about the video, transform those memories into a linguistic code, and then move my fingers around a keyboard in order to type linguistic descriptions of my memories.

After thinking about your experience with this demonstration, do you have a stronger sense of what is meant by the term "cognition?" Information from the environment was taken in through sensory systems, and it was linked to knowledge that you possess. New memories (of your experiences while watching and interpreting the video) were created. And, they were accessed at a later point in time in order for you to write out descriptions of your interpretation of the video. In this sense, you acquired, stored, transformed, and used knowledge that you gleaned from experience.

Why should you and other students learn about cognition? One reason is that the cognitive approach has widespread influence on other areas of psychology, such as clinical psychology and psychotherapy (e.g., Erdelyi & Goldberg, 2014; Gu, Strauss, Bond, & Cavanagh, 2015; Snyder, Miyake, & Hankin, 2015), educational psychology (O'Donnell & King, 2014; Schonert-Reichl et al., 2015), and social psychology (e.g., Seyfarth & Cheney, 2015; Srull & Wyer, 2015; Todd, Thiem, & Neel, 2016). Let's consider an example from clinical psychology. One cognitive task asks people to recall a specific memory from their past. People who are depressed tend to provide a general summary, such as "visiting my grandmother." In contrast, people who are not depressed tend to describe an extended memory that lasts more than one day, such as "the summer I drove across the country" (Wenzel, 2005). Whether a person is depressed or not thus influences an individual's ability to access and report experiences from their memories. Relatedly, cognitive psychology also influences interdisciplinary areas. A journal called *Cognitive Neuropsychology*, for example, publishes research that examines specific neurological problems—such as an extreme difficulty in recognizing people's faces—when other cognitive skills are normal (e.g., Wilson et al., 2010).

Another reason to study cognitive psychology is that cognition occupies a major portion of human psychology as it relates to your daily life experiences. In fact, almost everything you have done in the past hour required you to perceive, remember, use language, or think. As you'll soon see, psychologists have discovered some impressive information about every topic in cognitive psychology. Even though cognitive psychology is extraordinarily central in every human's daily life, many college students cannot define this term accurately (Maynard, 2006; Maynard et al., 2004). For a demonstration of this point, try Demonstration 1.1.

Demonstration 1.1**Awareness About Cognitive Psychology**

Locate several friends at your university or college who have not enrolled in any psychology courses. Ask each person the following questions:

1. How would you define the term “cognitive psychology”?
2. Can you list some of the topics that would be included in a course in cognitive psychology?

When Amanda Maynard and her coauthors (2004) asked introductory psychologists to define “cognitive psychology,” only 29% provided appropriate definitions. How adequate were the responses that your own friends provided?

The final reason for studying cognition is more personal. Your mind is an impressively sophisticated piece of equipment, and you use this equipment every minute of the day. If you purchase a new cellphone, you typically receive a brochure that describes its functions (or nowadays, at least a link to a website with this information). No one ever issued, however, a brochure for your mind when you were born. In a sense, this textbook is like a brochure or owner’s manual, describing information about how your mind works. Understanding cognition = understanding the abilities that provide you with the experience of a rich internal mental life.

Historical Perspective on the Field

The cognitive approach to psychology traces its origins to the classical Greek philosophers and to developments that began in the 19th century. As we will also see in this section, however, the contemporary version of cognitive psychology emerged within the last 60–70 years. In this section, we first consider a set of historical developments that led to the emergence of the field of experimental psychology. We then focus briefly on a series of events that contributed to the emergence of cognitive psychology—a field that is widely viewed as a key subdiscipline of psychology. To conclude this section, we consider the nature of cognitive psychology as it exists in present times.

Origins of Cognitive Psychology

Philosophers and other theorists have speculated about human thought processes for more than 23 centuries. For example, the Greek philosopher Aristotle (384–322 BCE) examined topics such as perception, memory, and mental imagery. He also discussed how humans acquire knowledge through experience and observation (Barnes, 2004; Sternberg, 1999). Aristotle emphasized the importance of **empirical evidence**, or scientific evidence obtained by careful observation and experimentation. His emphasis on empirical evidence and many of the topics he studied are consistent with 21st-century cognitive psychology. In fact, Aristotle can reasonably be called the first cognitive psychologist (Leahey, 2003). Psychology as a discipline in and of itself did not emerge, however, until the late 1800s.

Wilhelm Wundt

Most scholars who study the history of psychology believe that Wilhelm Wundt (pronounced “Voont”) should be considered the founder of experimental psychology (Benjamin, 2009; Pickren & Rutherford, 2010). Wundt lived in Leipzig, Germany, between 1832 and 1920. Students traveled from around the world to study with Wundt, who taught about 28,000 students during the course of his lifetime (Bechtel et al., 1998; Benjamin, 2009; Fuchs & Milar, 2003).

Wundt proposed that psychology should study mental processes, and advocated the use of a technique called introspection in order to do so. In this case, **introspection** meant that carefully trained observers would systematically analyze their own sensations and report them as objectively as possible, under standardized conditions (Blumenthal, 2009; Pickren & Rutherford, 2010; Zangwill, 2004b). For example, observers might be asked to objectively report their reactions to a specific musical chord, and to do so without relying on their previous knowledge about music.

Wundt’s introspection technique sounds subjective, not objective, to most current cognitive psychologists. As you’ll see throughout this textbook, our introspections are sometimes inaccurate (Wilson, 2009;

Zangwill, 2004b). For example, you may introspect that your eyes are moving smoothly across this page of your textbook. As we will discuss in Chapter 3, however, cognitive psychologists have determined that your eyes actually move in small jumps while you are reading.

Early Memory Researchers

One of the earliest (1850–1909) systematic investigations of a cognitive process came from the German psychologist Hermann Ebbinghaus (Baddeley et al., 2009; Schwartz, 2011). Ebbinghaus was interested in human memory. He examined a variety of factors that might influence performance on memory tasks, such as the amount of time between two presentations of a list of items. He frequently chose nonsense syllables (e.g., DAX), rather than actual words. This precaution reduced the potentially confounding effects of people's previous experience with language on their ability to recall information from their memories (Fuchs & Milar, 2003; Zangwill, 2004a).

Meanwhile, in the United States, similar research was being conducted by psychologists such as Mary Whiton Calkins (1863–1930). Calkins reported a memory phenomenon called the recency effect (Schwartz, 2011). The **recency effect** refers to the observation that our recall is especially accurate for the final items in a series of stimuli (such as a list of words or numbers). In addition, Calkins emphasized that psychologists should study how real people use their cognitive processes in the real world, as opposed to in artificial laboratory tasks (Samelson, 2009). Calkins was also the first woman to be president of the American Psychological Association. In connection with that role, she developed guidelines for teaching college courses in introductory psychology (Calkins, 1910; McGovern & Brewer, 2003). During her career, Calkins also published four books and more than 100 scholarly papers (Pickren & Rutherford, 2010).

William James

Another central figure in the history of cognitive psychology was an American named William James (1842–1910). James was not impressed with Wundt's introspection technique or Ebbinghaus's research with nonsense syllables. Instead, James preferred to theorize about our everyday psychological experiences (Benjamin, 2009; Hunter, 2004a; Pickren & Rutherford, 2010). He is best known for his textbook *Principles of Psychology*, published in 1890.

Principles of Psychology provides clear, detailed descriptions about people's everyday experiences (Benjamin, 2009). It also emphasizes that the human mind is active and inquiring. James's book foreshadows numerous topics that fascinate 21st-century cognitive psychologists, such as perception, attention, memory, understanding, reasoning, and the tip-of-the-tongue phenomenon (Leary, 2009; Pickren & Rutherford, 2010). Consider, for example, James's vivid description of the tip-of-the-tongue experience:

Suppose we try to recall a forgotten name. The state of our consciousness is peculiar. There is a gap therein but no mere gap. It is a gap that is intensely active. A sort of wraith of the name is in it, beckoning us in a given direction, making us at moments tingle with the sense of our closeness and then letting us sink back without the longed-for term.

(James, 1890, p. 251)

Behaviorism

The work of early memory researchers such as Ebbinghaus and Calkins appealed to the notion that information is somehow stored in the mind. Their work suggested that internally stored knowledge about words or objects was one important component of cognitive processing. During the first half of the 20th century, however, behaviorism became the most prominent theoretical perspective in the United States. According to the principles of **behaviorism**, psychology must focus on objective, observable reactions to stimuli in the environment, rather than on subjective processes such as introspection (Benjamin, 2009; O'Boyle, 2006).

The most prominent early behaviorist was the U.S. psychologist John B. Watson (1913), who lived from 1878 to 1958. Watson and other behaviorists emphasized observable behavior, and they typically studied nonhuman animals (Benjamin, 2009). Most behaviorists believed that it was inappropriate to theorize and speculate about unobservable components of mental life. As a result, the behaviorists did not study concepts such as a mental image, an idea, or a thought (Epstein, 2004; Skinner, 2004). Instead, the

behaviorists focused heavily on learning. That is, they were particularly interested in quantifying the manner in which changes in an organism's environment produced changes in its behavior.

It is possible to objectively quantify how well an organism has learned about properties of its environment. For example, consider placing a rat in a complicated maze—the end of which contains a piece of cheese for the rat to enjoy as a reward for making it through the maze. Rewarding rats for successfully navigating to the end of a maze provides researchers with an opportunity to objectively measure learning. For example, researchers may choose to count the number of errors made by the rat (such as a turn down a dead-end path) while completing the maze on each of 30 consecutive days. A decrease in error rate over time, in this case, is interpretable as representing an increase in learning. Because researchers can quantify learning over time, they also have the ability to systematically manipulate properties of the learning task, such as maze complexity, in order to determine what factors influence the speed of learning. Note here, however, that in behaviorist experiments, clear and quantifiable manipulations of the learning environment were implemented in order to examine how they influenced a quantifiable metric of learning. The behaviorists never argued or otherwise appealed to the notion that a rat may be storing information about the spatial layout of the maze (and thus, *internally representing* visual and spatial components of the maze) as they learned about its layout over time.

The lack of a willingness to acknowledge that information about one's environment is stored and can be accessed at some later point in time led to a reaction against strong versions of behaviorist doctrine. In fact, examples of "pure behaviorism" are now difficult to locate. For instance, the Association of Behavioral Therapy is now known as the Association for Behavioral and Cognitive Therapies. Recent articles in their journal, *Cognitive and Behavioral Practice*, have focused on using cognitive behavioral therapy for a variety of clients, including people with eating disorders, elderly adults with posttraumatic stress disorder, and severely depressed adolescents.

Although the behaviorists did not conduct research in cognitive psychology, they did contribute significantly to contemporary research methods. For example, behaviorists emphasized the importance of the **operational definition**, a precise definition that specifies exactly how a concept is to be measured. Similarly, cognitive psychologists in the 21st century need to specify exactly how memory, perception, and other cognitive processes will be measured in an experiment. Behaviorists also valued carefully controlled research, a tradition that is maintained in current cognitive research (Fuchs & Milar, 2003). We must also acknowledge the important contribution of behaviorists to applied psychology. Their learning principles have been used extensively in psychotherapy, business, organizations, and education (Craske, 2010; O'Boyle, 2006; Rutherford, 2009).

Try Demonstration 1.2 before you read further.

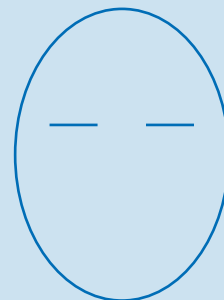
The Gestalt Approach

Behaviorism thrived in the United States for several decades, although it had less influence on European psychology (G. Mandler, 2002). An important development in Europe at the beginning of the 20th century was gestalt (pronounced "geh-*shtahl*") psychology. **Gestalt psychology** emphasizes that we humans have basic tendencies to actively organize what we see, and furthermore, that the whole is greater than the sum of its parts (Benjamin, 2009).

Demonstration 1.2

An Example of Gestalt Psychology

Quickly look at the figure below and describe what you see. Keep your answer in mind until the next page, when we will discuss this figure.



Consider, for example, the figure represented in Demonstration 1.2. You probably saw a human face, rather than simply an oval and two straight lines. This figure seems to have unity and organization. It has a **gestalt**, or overall quality that transcends the individual elements (Fuchs & Milar, 2003).

Gestalt psychologists valued the unity of psychological phenomena. As a result, they strongly objected to Wundt's introspective technique of analyzing experiences into separate components (Pickren & Rutherford, 2010). They also criticized the behaviorists' emphasis on breaking behavior into observable stimulus–response units and ignoring the context of behavior (Baddeley et al., 2009; Benjamin, 2009). Gestalt psychologists constructed a number of laws that explain why certain components of a pattern seem to belong together. In Chapter 2, we'll consider some of these laws, which help us to quickly recognize visual objects.

Gestalt psychologists also emphasized the importance of insight in problem solving (Fuchs & Milar, 2003; Viney & King, 2003). When you are trying to solve a problem, the parts of the problem may initially seem unrelated to each other. However, with a sudden flash of insight, the parts fit together into a solution. Gestalt psychologists conducted most of the early research in problem solving. In Chapter 11 of this textbook, we will examine their concept of insight, as well as more recent developments.

Frederic Bartlett

In the early 1900s, the behaviorists were dominant in the United States, and the gestalt psychologists were influential in continental Europe. Meanwhile in England, a British psychologist named Frederic Bartlett (1886–1969) conducted his research on human memory. His important book *Remembering: An Experimental and Social Study* (Bartlett, 1932) is considered one of the most influential books in the history of cognitive psychology (Benjamin, 2009). Bartlett rejected the carefully controlled research of Ebbinghaus (Pickford & Gregory, 2004). Instead, he used meaningful materials, such as lengthy stories.

Bartlett discovered that people made systematic errors when trying to recall these stories. He proposed that human memory is an active, constructive process, in which we interpret and transform the information we encounter. We search for meaning, trying to integrate this new information so that it is more consistent with our own personal experiences (Benjamin, 2009; Pickford & Gregory, 2004; Pickren & Rutherford, 2010).

Bartlett's work was largely ignored in the United States during the 1930s, because most U.S. research psychologists were committed to behaviorism. However, about half a century later, U.S. cognitive psychologists discovered Bartlett's work and admired his use of naturalistic material, in contrast to Ebbinghaus's artificial nonsense syllables. Bartlett's emphasis on a schema-based approach to memory foreshadowed some of the research we will explore in Chapters 5 and 8 (Benjamin, 2009; Pickford & Gregory, 2004).

Cognitive Revolution

By the late 1930s and throughout the 1940s, psychologists were becoming increasingly disappointed with the behaviorist outlook that had dominated U.S. psychology in previous decades. It was difficult to explain complex human behavior using only behaviorist concepts such as observable stimuli, responses, and reinforcement (G. Mandler, 2002; Neisser, 1967). Research in human memory began to blossom at the end of the 1950s, further increasing the disenchantment with behaviorism. Psychologists proposed models of human memory instead of focusing only on models of animal learning (Baddeley et al., 2009; Bower, 2008). The behaviorist approach tells us little about numerous psychologically interesting processes, such as the thoughts and strategies that people use when they try to solve a problem (Bechtel et al., 1998), or how people access their stored knowledge about language in order to produce a sentence.

Another influential force came from research on children's thought processes. Jean Piaget (pronounced "Pea-ah-zhay") was a Swiss theorist who lived from 1896 to 1980. Piaget's books began to attract the attention of U.S. psychologists and educators toward the end of the 1950s, and his perspectives continue to shape developmental psychology (Feist, 2006; Hopkins, 2011; Pickren & Rutherford, 2010). According to Piaget, children actively explore their world in order to understand important concepts (Gregory, 2004b). Children's cognitive strategies change as they mature, and adolescents often use sophisticated strategies in order to conduct their own personal experiments about how the world works.

Research and theory from other academic and intellectual fields also increased the emerging popularity of the study of human cognition (Bermudez, 2014). For example, new developments in linguistics increased psychologists' dissatisfaction with behaviorism (Bargh & Ferguson, 2000; Bower, 2008). The most important contributions came from the linguist Noam Chomsky (1957), who emphasized that the structure of language was too complex to be explained in behaviorist terms (Pickren & Rutherford, 2010; Pinker, 2002). Chomsky and other linguists argued that humans have an inborn ability to master all the complicated and varied aspects of language (Chomsky, 2004). This perspective clearly contradicted the behaviorist perspective that language acquisition can be entirely explained by the same kinds of learning principles that apply to laboratory animals.

The growing support for the cognitive approach is often referred to as the “cognitive revolution” (Bruner, 1997; Shiraev, 2011). This term refers to a strong shift away from behaviorist approaches to the study of human behavior. Instead, experimental psychologists began to focus on how organism-internal processes, such as memory, attention, and language, work together to give rise to the human ability to consciously perceive, interpret, and act in the world around them.

We have traced the historical roots of cognitive psychology and provided a brief overview of reasons that psychologists became disenchanted with the behaviorist worldview. But, when was the field of cognitive psychology actually “born”? Cognitive psychologists generally agree that the birth of cognitive psychology can be listed as 1956 (Eysenck & Keane, 2010; G. Mandler, 2002; Thagard, 2005). During this prolific year, researchers published numerous influential books and articles on attention, memory, language, concept formation, and problem solving. In 1967, an influential psychologist named Ulric Neisser (1928–2012) published a book called *Cognitive Psychology*. The publication of this book served as one of the first comprehensive treatments of cognitive processing. It is seen as one of the most important factors contributing to the emergence of cognitive psychology as a field. In fact, because Neisser was the first person to use the term “Cognitive Psychology,” he has often been called “the father of cognitive psychology” (e.g., *American Psychological Science*, n.d.).

Cognitive Psychology in Present Times

Since the cognitive revolution and the onset of cognitive psychology as a field, cognitive psychology has had an enormous influence on the discipline of psychology. For example, almost all psychologists now recognize the importance of mental representations, a term that behaviorists would have rejected in the 1950s. Indeed, all areas of psychology incorporate key principles from cognitive psychology in their models of human development and behavior. For instance, psychologists are also studying how cognitive processes operate in our everyday social interactions (e.g., Cacioppo & Berntson, 2005a; Cameron, Payne, & Doris, 2013; Critcher, Inbar, & Pizzaro, 2013; Easton & Emery, 2005; Neel, Neufeld, & Neuberg, 2013; Todd & Burgmer, 2013). Demonstration 1.3 illustrates the important influence of cognitive psychology in many other areas of psychological inquiry.

Cognitive psychology has its critics, however. One common complaint concerns the issue of ecological validity. Studies are high in **ecological validity** if the conditions in which the research is conducted are similar to the natural setting where the results will be applied.

In contrast, consider an experiment in which participants must memorize a list of unrelated English words, presented at 5-second intervals on a white screen in a barren laboratory room. Half of the people are instructed to create a vivid mental image of each word; the other half receive no instructions. The experiment is carefully controlled. The results of this experiment would tell us something about the way memory operates. However, this task is probably low in ecological validity because it cannot be applied to the way people learn in the real world (Sharps & Wertheimer, 2000). How often do you try to memorize a list of unrelated words in this fashion?

Demonstration 1.3

The Widespread Influence of Cognitive Psychology

Locate a psychology textbook used in some other class. An introductory textbook is ideal, but textbooks in developmental psychology, social psychology, abnormal psychology, etc., are all suitable. Glance through the subject index for terms beginning with

cognition or *cognitive*, and locate the relevant pages. Depending on the nature of the textbook, you may also find entries under terms such as memory, language, and perception.

Most cognitive psychologists prior to the 1980s did indeed conduct research in artificial laboratory environments, often using tasks that differed from daily cognitive activities. However, current researchers frequently study real-life issues. For example, Chapter 3 describes how people are much more likely to make driving errors if they are talking on a handheld cell phone (Folk, 2010). Furthermore, Chapters 5 and 6 discuss numerous methods for improving your memory (e.g., Davies & Wright, 2010a). Chapter 12 provides many suggestions about how to improve your decision-making ability (Kahneman, 2011). In general, most cognitive psychologists acknowledge that the discipline must advance by conducting both ecologically valid and laboratory-based research.

Mind, Brain, and Behavior

By the mid-1970s, the cognitive approach had replaced the behaviorist approach as the dominant theory in psychological research (Robins et al., 1999). But, cognitive psychology as it exists today has become an increasingly interdisciplinary pursuit. The rigorous experimental approach to psychological research that is characteristic of cognitive psychology has become increasingly supplemented by theories and methodologies borrowed from other fields. In this section, we first consider the interdisciplinary field of cognitive science. Indeed, researchers from many different fields have interests in how the human mind works. As we will see, cross-disciplinary research can produce synthetic contributions to our understanding of the human mind that transcend the contributions from any individual discipline. Next, we touch on theoretical questions concerning how the concept of “the mind” relates to the human brain. To conclude, we will provide an overview of cognitive neuroscience methodologies. These methodologies allow us to gain insight into how our neural hardware supports different cognitive processes.

Cognitive Science

Cognitive psychology is part of a broad field known as cognitive science. **Cognitive science** is an interdisciplinary field that tries to answer questions about the mind. Cognitive science includes contributions from cognitive psychology, neuroscience, computer science, philosophy, and linguistics. In some cases, researchers in the fields of sociology, anthropology, and economics also make contributions to the field of cognitive science. This field emerged when researchers began to notice connections among a variety of disciplines, and thus began to collaborate with one another (Bermúdez, 2010; Sobel, 2001; Thagard, 2005).

According to cognitive scientists, thinking requires us to manipulate our internal representations of the external world. Cognitive scientists focus on these internal representations. Cognitive scientists value interdisciplinary studies, and they try to build bridges among the academic areas. Both the theory and the research in cognitive science are so extensive that no one person can possibly master everything (Bermúdez, 2010; Sobel, 2001; Thagard, 2005). However, if all these different fields remain separate, then cognitive scientists won’t achieve important insights and identify relevant connections. Therefore, cognitive science tries to coordinate the information that researchers have gathered throughout each relevant discipline.

Below, we examine just one of many examples that highlight the value of interdisciplinary communication when trying to understand the inner workings of the human mind. More specifically, we look at how interactions between cognitive psychologists and computer scientists have produced deeper insight into cognition than would otherwise be possible.

Artificial Intelligence

Artificial intelligence (AI) is a branch of computer science. It seeks to explore human cognitive processes by creating computer models that show “intelligent behavior” and also accomplish the same tasks that humans do (Bermúdez, 2010; Boden, 2004; Chrisley, 2004). Researchers in artificial intelligence have tried to explain how humans recognize a face, create a mental image, and write a poem, as well as hundreds of additional cognitive accomplishments (Boden, 2004; Farah, 2004; Thagard, 2005).

We need to draw a distinction between “pure AI” and computer simulation. **Pure artificial intelligence** is an approach that designs a program to accomplish a cognitive task as efficiently as possible, even if the computer’s processes are completely different from the processes used by humans. For example, the most