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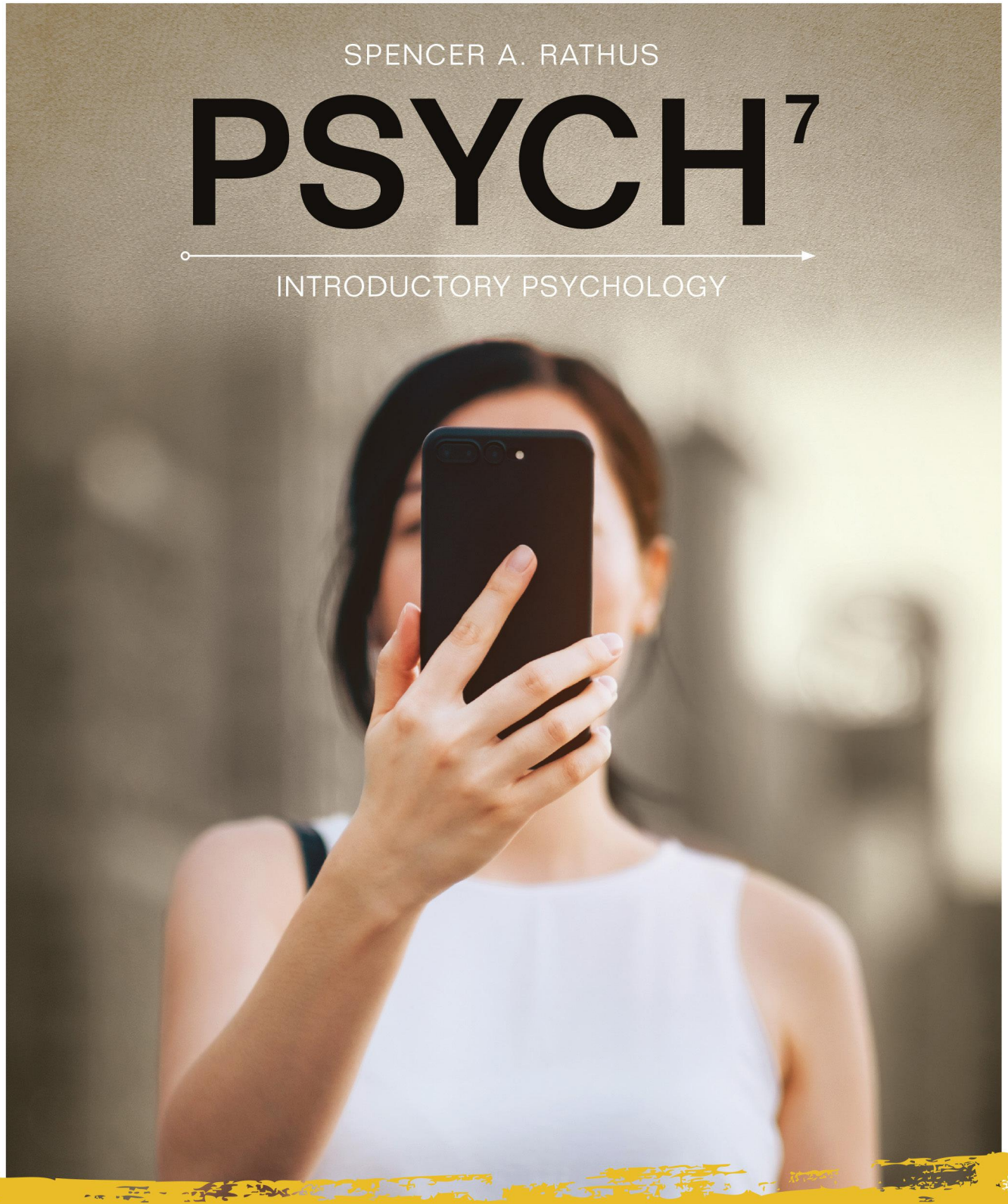
SPENCER A. RATHUS

PSYCH[7]

INTRODUCTORY PSYCHOLOGY



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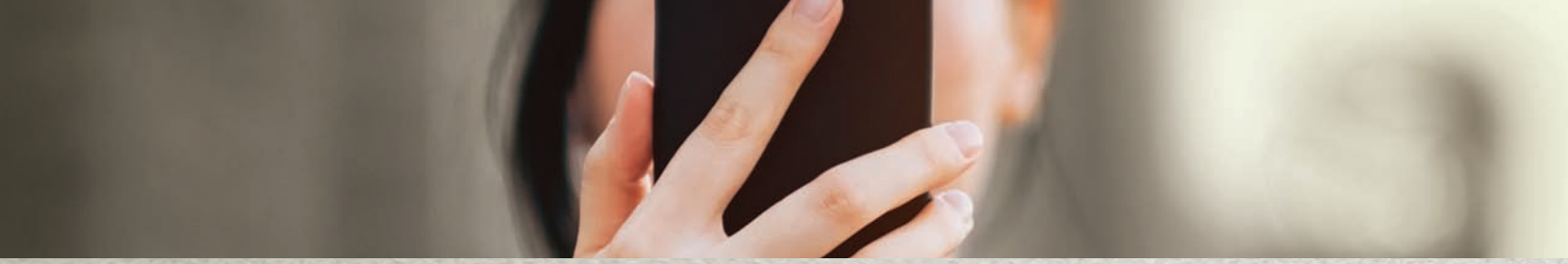

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SPENCER A. RATHUS

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***Psych*[7]**
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SPENCER A. RATHUS

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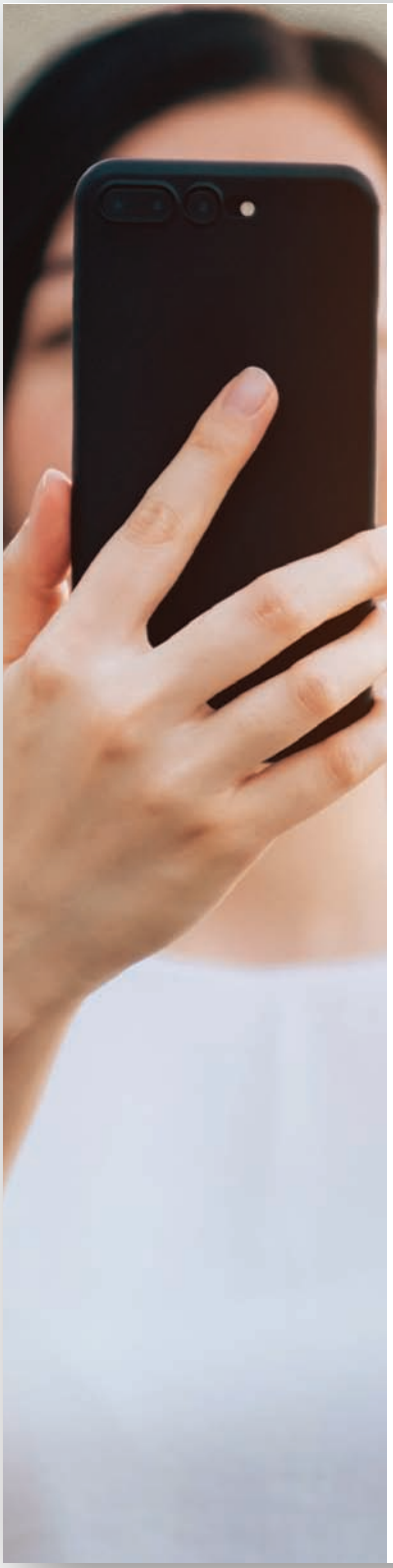
BRIEF CONTENTS



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1 What Is Psychology?

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LEARNING OUTCOMES

After studying this chapter, you will be able to . . .

- **1-1** Define *psychology* and describe what psychologists do.
- **1-2** Describe the origins of psychology and discuss people who have made significant contributions to the field.
- **1-3** Identify the theoretical perspectives from which psychologists today view behavior and mental processes.
- **1-4** Outline the scientific method, and explain the relationship between samples and populations.
- **1-5** Explain how psychologists engage in research—including methods of observation, correlation, and experimentation—to learn about behavior and mental processes.
- **1-6** Identify and discuss principles of critical thinking.
- **1-7** Discuss ethical standards that govern psychological research and practice with humans and animals.

My favorite place: The checkout counter of the supermarket. After being buffeted about by the crowds in the aisles and trying to convince myself that I really will survive until the people in line ahead of me are checked out, I am rewarded by the display of all the supermarket tabloids. The headlines cry out. Each week, there are 10 new sightings of Elvis and 10 new encounters with extraterrestrials. There are 10 new "absolutely proven effective" ways to take weight off and 10 new ways to conquer stress and depression. There are 10 new ways to tell if your partner has been cheating and, of course, 10 new predictions by astrologers and psychics.

Bloomberg/Getty Images

Truth or Fiction?
The world is flooded with sense and nonsense. How can you sort out truth from fiction?

Extraterrestrials regularly kidnap us Earthlings. Although they possess the technology to leap between the stars, aliens must apparently prod and poke us to figure out how we work. While we update our iPhones with the latest apps and music, tabloid drawings suggest that aliens have been using the same-model flying saucer for decades. Their sense of style is nothing to text home about.

Although we can find some humor in tales of abduction by aliens, psychologists and other scientists are interested in the questions these tales raise about human nature and the distinctions between sensationalism and science. What do we know about people who claim to have been abducted by aliens? How can we sort truth from fiction and decide whether we will believe them?

Psychologists who have studied claimed alien kidnappings conclude that the kidnappings never occurred. However, the people making the claims are not necessarily mentally ill, nor are they necessarily lying (Finkelstein, 2017; Ladd & Borshuk, 2013). By and large, these are people who have remembered their experiences while undergoing therapy, often under hypnosis. Tales of alien abduction are widely known throughout our culture, so it is not at all surprising that the "memories" of people who claim to have been abducted would tend to coincide (Finkelstein, 2017).

Abductees generally claim that they are awakened in their sleep by the aliens and unable to move. Psychologists know that many of our voluntary muscles—the ones involved in movement—are "paralyzed" when we sleep, which is why we usually don't thrash about (and assault our bed partners) when we dream (Finkelstein, 2017; Torontali et al., 2014). *Hallucinations*—seeing and hearing things that are not really there—are quite common as we are waking from a sleep-paralyzed state, and it seems that the reported experiences of "abductees" fit the pattern.

Psychologists also know that people are quite open to suggestion (Loftus, 2017; Vyse, 2014).

TRUTH OR FICTION?

WHAT DO YOU THINK? FOLKLORE, COMMON SENSE, OR NONSENSE? SELECT T FOR "TRUTH" OR F FOR "FICTION," AND THEN CHECK THE ACCURACY OF YOUR ANSWERS AS YOU READ THROUGH THE CHAPTER.

T	F	Men receive the majority of doctoral degrees in psychology.
T	F	More than 2,000 years ago, Aristotle wrote a book on psychology with contents similar to those in the book you're now reading.
T	F	The ancient Greek philosopher Socrates suggested a research method that is still used in psychology.
T	F	Even though she had worked to complete all the degree requirements, the first female president of the American Psychological Association turned down the doctoral degree that was offered to her.
T	F	You could survey millions of voters and still not accurately predict the outcome of a presidential election.
T	F	In many experiments, neither the participants nor the researchers know who is receiving the real treatment and who is not.

Memories are not perfect snapshots. When trial witnesses are asked leading questions—questions that might encourage them to recall events in a certain way—the opposing attorney will usually object ("Leading the witness, your Honor"). Sometimes, the person interviewing the supposed kidnap victim asks leading questions, looking for experiences with aliens.

All in all, "UFO memories may be constructed from bits and pieces of sleep-related hallucinations, nightmares, and media attention, and fixed solidly into place with the suggestion of hypnosis and the validation of support groups" (Clark & Loftus, 1996). "Abductees" may also be trying to escape, temporarily, from their humdrum lives—as might be the buyers of supermarket tabloids (Finkelstein, 2017).

Psychologists have thus worked to explain how it can be that many people report being abducted by aliens and being subjected to tests by them. But is there *scientific evidence* that people have been abducted by aliens? In sum, when we subject the stories in the supermarket tabloids to scientific analysis, we usually find that they fall short of any reasonable standards of evidence.

This book will take you on a journey. It's not a journey into outer space. It's a journey into the inner space of thinking critically about the world around you, about stories and arguments made by other people, and about human behavior and mental processes. In our overview of reported alien abductions, we touched on people's memories, the state of consciousness known as sleep, hallucinations, hypnosis, the search for stimulating events, social influences on witnesses, and the effects of social support and the media. All these—and much, much more—lie within the province of psychology. We will see who psychologists are, what they do, what they have learned, and perhaps most important, how they sort out truth from fiction.

1-1 PSYCHOLOGY AS A SCIENCE

Psychology is the scientific study of behavior and mental processes. Topics of interest to psychologists include the nervous system, sensation and perception, learning and memory, intelligence, language, thought, growth and development, personality, stress and health, psychological disorders and ways of treating them, sexual behavior, and the behavior of people in social settings such as groups and organizations.

Sciences have certain goals. Psychology, like other sciences, seeks to describe, explain, predict, and control the events it studies. Psychology thus seeks to describe, explain, predict, and control behavior and mental processes. Note that the goal of *controlling* behavior and mental processes doesn't mean that psychologists seek ways to make people do their bidding, like puppets on strings. Rather, psychologists seek to understand the factors that influence behavior and apply this knowledge for the public good—for example, to help individuals cope with problems such as anxiety, depression, and social pressure.

psychology the science that studies behavior and mental processes

theory a set of hypothesized statements about the relationships among events

When possible, descriptive terms and concepts—such as anxiety and depression—are interwoven into **theories**. Theories propose reasons for relationships among events, as in perception of a threat can arouse feelings of anxiety. They allow us to derive explanations and predictions. Many psychological theories combine statements about behavior (such as eating or aggression), mental processes (such as attitudes and mental images), and biological processes. For instance, many of our responses to drugs such as alcohol and marijuana can be measured as overt behavior, and they are presumed to reflect our (mental) expectations about the drugs and the biological effects of the drugs themselves.

A satisfactory psychological theory allows us to predict behavior. For instance, a theory of hunger should allow us to predict when people will or will not eat. If our observations cannot be adequately explained by, or predicted from, a given theory, we should consider revising or replacing that theory.

The remainder of this chapter presents an overview of psychology as a science. You will see that psychologists have diverse interests and fields of specialization.

We discuss the history of psychology and the major perspectives from which today's psychologists view behavior. Finally, we consider the research methods psychologists use to study behavior and mental processes.

1-1a WHAT PSYCHOLOGISTS DO

Psychologists share a keen interest in behavior, but they may differ markedly in other ways. Psychologists engage in research, practice, and teaching. Some researchers engage primarily in basic, or pure, research. **Pure research** is undertaken because the researcher is interested in the research topic. Pure research has no *immediate* application to personal or social problems and has therefore been characterized as research for its own sake. However, although pure research is sparked by curiosity and the desire to know and understand, today's pure research frequently enhances tomorrow's way of life. For example, pure research on learning and motivation in pigeons, rats, and monkeys done early in the 20th century has found applications in today's school systems. It has shown, for example, that learning often takes time and repetition and also profits from "booster shots" (repetition after the learning goal has been reached). Pure research into the workings of the nervous system has enhanced knowledge of disorders such as epilepsy, Parkinson disease, and Alzheimer disease. Other psychologists engage in **applied research**, which is designed to find solutions to specific personal or social problems.

Many psychologists do not conduct research. Instead, they *practice* psychology by applying psychological knowledge to help individuals change their behavior so that they can meet their own goals more effectively. Still other psychologists primarily teach. They share psychological knowledge in classrooms, seminars, and workshops. Psychologists may also engage in all three: research, practice, and teaching.

1-1b FIELDS OF PSYCHOLOGY

Psychologists are found in a number of specialties. Although some psychologists wear more than one hat, most carry out their functions in the following fields.

Clinical psychologists help people with psychological disorders adjust to the demands of life. Clinical psychologists evaluate problems such as anxiety and depression through interviews and psychological tests. They help clients resolve problems and change self-defeating behavior. For example, they may help clients face "threats," such as public speaking, by exposing them gradually to situations in which they make presentations to actual or virtual groups (see virtual therapy in Chapter 13). Clinical psychologists are the largest subgroup of psychologists (see Figure 1.1). *Counseling psychologists*, like clinical psychologists, use interviews and tests to define their clients' problems. Their clients typically have adjustment problems but not serious psychological disorders. For example, clients may have trouble making academic or vocational decisions; LGBT clients may have difficulty coping with prejudice and discrimination.

School psychologists are employed by school systems to identify and assist students who have problems that interfere with learning. They help schools make decisions about the placement of students in special classes. *Educational psychologists*, like school psychologists, attempt to facilitate learning, but they usually focus on course planning and instructional methods for a school system rather than on individual children. Educational psychologists research issues such as how learning is affected by psychological factors such as motivation and intelligence, by sociocultural factors such as poverty and acculturation, and by teachers.

Developmental psychologists study the changes—physical, cognitive, social, and emotional—that occur throughout the lifespan. They attempt to sort out the influences of heredity and the environment on development.

Personality psychologists identify and measure human traits and determine influences on human thought processes, feelings, and behavior. They are particularly concerned with issues such as anxiety, aggression, sexual orientation, and gender roles.

Social psychologists are concerned with the nature and causes of individuals' thoughts, feelings, and behavior in social situations. Whereas personality psychologists tend to look within the person to explain behavior, social psychologists tend to focus on social influences.

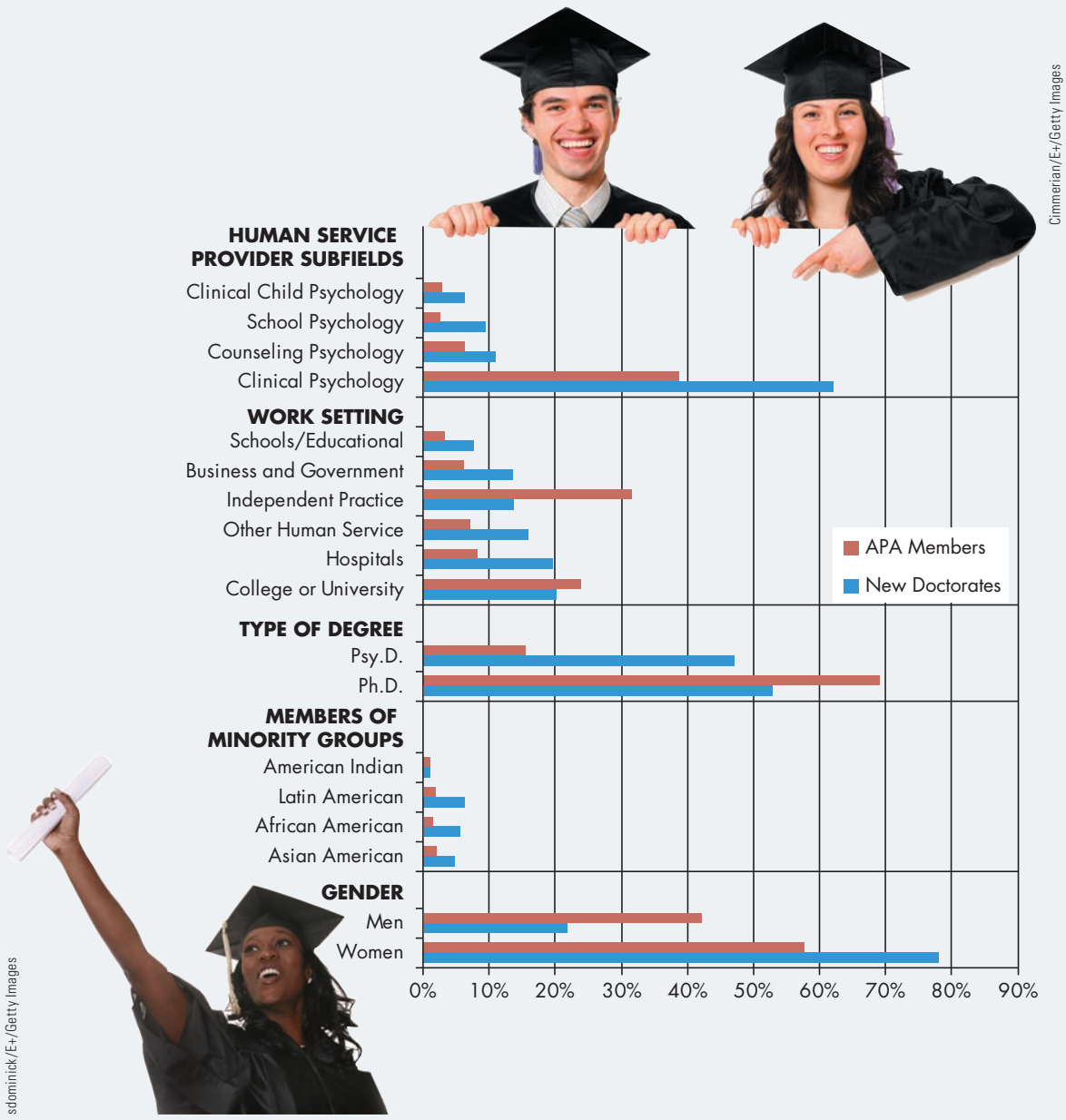
Environmental psychologists study the ways that people and the environment—the natural environment and the human-made environment—influence one another. For example, we know that extremes of temperature and loud noises interfere with learning in school. Environmental psychologists study ways to encourage people to recycle, preserve bastions of wilderness, and address climate change.

Psychologists in all specialties may conduct experiments. However, those called *experimental psychologists* specialize in

pure research research conducted without concern for immediate applications

applied research research conducted in an effort to find solutions to particular problems

FIG. 1.1 THE PSYCHOLOGISTS: PSYCHOLOGISTS WITH NEW DOCTORATES VERSUS MEMBERS OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION (APA)



More women and members of ethnic minorities are entering the field of psychology today. The percentage of new psychologists with PsyD degrees is also growing.

Source: Adapted from the American Psychological Association (2009). *Doctoral Psychology Workforce Fast Facts*. Health Service Provider Subfields. Retrieved from http://research.apa.org/fastfacts-09.pdf. 2009 APA Center for Workforce Studies, Washington, DC; and from American Psychological Association (2014). *2013 APA Directory*. Compiled by APA Center for Workforce Studies, Tables 1, 2, 3, 4. APA Center for Workforce Studies, Washington, DC.

basic processes such as the nervous system, sensation and perception, learning and memory, thought, motivation, and emotion. For example, experimental psychologists have studied what areas of the brain are involved in processing math problems or listening to music. They use people or animals, such as pigeons and rats, to study learning.

Industrial psychologists focus on the relationships between people and work. *Organizational psychologists* study the behavior of people in organizations such as

Martyn Evans/Alamy Stock Photo

The Origins of Aggression?

Why are TV crime shows so popular? Why are people fascinated by psychopaths? Why do so many boys and men enjoy playing video games such as Grand Theft Auto, God of War, Call of Duty, and Battlefield? Psychologists investigate the origins of aggression and violence. They have found that aggressive people and mass murderers are more likely to play violent video games. Does this mean that violent video games cause violent behavior? Could it also mean that violent individuals are more likely to seek out the games? Could both be true? (More on this in Chapter 5.)

businesses. *Human factors psychologists* make technical systems such as automobile dashboards and computer keyboards more user-friendly. *Consumer psychologists* study the behavior of shoppers in an effort to predict and influence their behavior. They advise store managers on how to lay out the aisles of a supermarket in ways that boost impulse buying, how to arrange window displays to attract customers, and how to make newspaper ads and TV commercials more persuasive.

Health psychologists study the effects of stress on health problems such as headaches, cardiovascular disease, and cancer. Health psychologists also guide clients toward more healthful behavior patterns, such as exercising and quitting smoking.

FICTION

It is **not true** that men receive the majority of doctoral degrees in psychology. Women do.

Forensic psychologists apply psychology to the criminal justice system. They deal with legal matters such as whether a defendant was sane when the crime was committed. Forensic psychologists may also treat psychologically ill offenders, consult with attorneys on matters such as picking a jury, and analyze offenders' behavior and mental processes. They may conduct research on matters ranging from evaluation of eyewitness testimony to methods of interrogation.

Sports psychologists help athletes concentrate on their performance and not on the crowd, use cognitive strategies such as positive visualization (imagining themselves making the right moves) to enhance performance, and avoid choking under pressure.

1-2 HISTORICAL FOUNDATIONS OF PSYCHOLOGY

Have you heard the expression "Know thyself"? It was proposed by the ancient Greek philosopher Socrates about 2,500 years ago. Psychology, which is in large part the endeavor to know ourselves, is as old as history and as modern as today. Knowledge of the history of psychology allows us to appreciate its theoretical conflicts, its place among the sciences, the evolution of its methods, and its social and political roles.

Another ancient contributor to psychology was the Greek philosopher Aristotle (384–322 BCE). In a treatise on

ARISTOTLE

Although he lived 2,400 years ago, the Greek philosopher Aristotle made many contributions to contemporary psychology:

- **He argued that science could rationally treat only information gathered by the senses.**
- **He enumerated the so-called five senses of vision, hearing, smell, taste, and touch.**
- **He explored the nature of cause and effect.**
- **He pointed out that people differ from other living things in their capacity for rational thought.**
- **He outlined laws of associationism that have lain at the heart of learning theory for more than two millennia.**
- **He also declared that people are motivated to seek pleasure and avoid pain—a view that remains as current today as it was in ancient Greece.**

psychology, Aristotle argued that human behavior, like the movements of the stars and the seas, is subject to rules and laws. Then he delved into his subject matter topic by topic: personality, sensation and perception, thought, intelligence, needs and motives, feelings and emotions, and memory.

TRUTH

It is **true** that Aristotle wrote a book on psychology with contents similar to the one you're now reading more than 2,000 years ago. In fact, the outline for this text could have been written by Aristotle.

Other ancient Greek philosophers also contributed to psychology. Around 400 BCE, Democritus suggested that we could think of behavior in terms of a body and a mind. (Contemporary psychologists still talk about the interaction of biological and mental processes.) He pointed out that our behavior is influenced by external stimulation. Democritus was one of the first to raise the question of whether there is free will or choice. Putting it another way, where do the influences of others end and our "real selves" begin? And what do we mean by a "real" self?

Socrates suggested that we should rely on rational thought and **introspection**—careful examination of one's own thoughts and emotions—to gain self-knowledge. He also pointed out that people are social creatures who influence one another.

Had we room enough and time, we could trace psychology's roots to thinkers farther back in time than the ancient Greeks, and we could trace its development through the great thinkers of the Renaissance and the Enlightenment. As it is, we must move on to the development of psychology as a laboratory science during the second half of the 19th century. Some historians set the marker date at 1860. It was then that Gustav Theodor Fechner (1801–1887) published his landmark book *Elements of Psychophysics*, which showed how physical events (such as lights and sounds) stimulate psychological sensations and perception. Fechner also showed how we can scientifically measure the effect of these events. Most historians set the debut of modern psychology as a laboratory science in the year 1879, when Wilhelm Wundt established the first psychological laboratory in Leipzig, Germany.

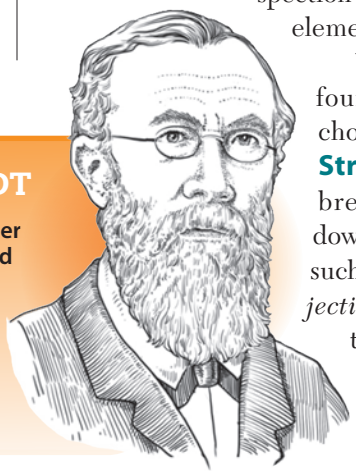
TRUTH

Yes, **true**, Socrates did suggest a research method that is still used in psychology—introspection. The method is based on Socrates's advice to "Know thyself," which has remained a motto of psychology.

1-2a STRUCTURALISM

German psychologist Wilhelm Wundt (1832–1920) looked as if he were going to be a problem child. He did poorly in elementary school—his mind would wander—and he had to repeat a grade. Eventually he attended medical school because he wanted to earn a decent living. But he did not like working with patients and dedicated himself to philosophy and psychology.

Like Aristotle, Wundt saw the mind as a natural occurrence that could be studied scientifically, like light, heat, and the flow of blood. Wundt used introspection to try to discover the basic elements of experience.



WILHELM WUNDT

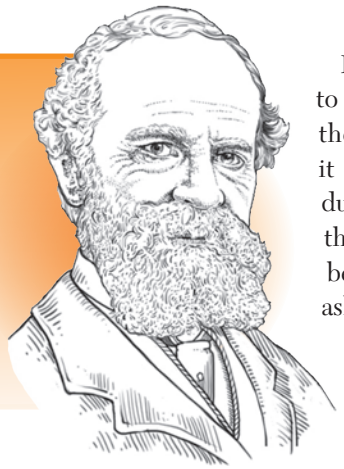
Wilhelm Wundt, the founder of structuralism, attempted to break down conscious experience into sensations such as sight and taste, emotions, and mental imagery.

Wundt and his students founded the school of psychology called *structuralism*. **Structuralism** attempted to break conscious experience down into *objective* sensations, such as sight or taste, and *subjective* feelings, such as emotional responses, and mental images such as memories or dreams. Structuralists believed that the mind

introspection deliberate looking into one's own cognitive processes to examine one's thoughts and emotions

structuralism the school of psychology that argues that the mind consists of three basic elements—sensations, feelings, and images—that combine to form experience

functions by combining objective and subjective elements of experience.



WILLIAM JAMES

William James wrote the first modern psychology textbook in 1890. He wrote, "I wished, by treating Psychology like a natural science, to help her become one."

1-2b FUNCTIONALISM

Toward the end of the 19th century, psychologist William James (1842–1910) became a major figure in the development of psychology in the United States. He focused on the relation between conscious experience and behavior. He argued, for example, that the stream of consciousness is fluid and continuous. Introspection convinced him that experience cannot be broken down into objective sensations and subjective feelings as the structuralists maintained.

William James was a founder of the school of **functionalism**, which focused on behavior as well as the mind or consciousness. Functionalists looked at how our experience helps us function more adaptively in our environments—for example, how habits help us cope with common situations. (When eating with a spoon, we do not create an individual plan to bring each morsel of food to our mouths.) They also turned to the laboratory for direct observations as a way to supplement introspection. Structuralists tended to ask, "What are the pieces that make up thinking and experience?" In contrast, functionalists tended to ask, "How do behavior and mental processes help people adapt to the requirements of their lives?"

James was also influenced by Charles Darwin's (1809–1882) theory of evolution. Earlier in the 19th century, the British naturalist Darwin had argued that organisms with adaptive features—that is, the "fittest"—survive and reproduce. Functionalists adapted Darwin's theory and proposed that adaptive behavior patterns are learned and maintained. Maladaptive behavior patterns tend to drop out, and only the fittest behavior patterns survive. These adaptive actions tend to be repeated and become habits. James wrote that "habit is the enormous flywheel of society." Habit keeps the engine of civilization running.

1-2c BEHAVIORISM

Imagine you have placed a hungry rat in a maze. It meanders down a pathway that ends in a *T*. It can then turn left or right. If you consistently reward the rat with food for turning right at this point, it will learn to turn right when it arrives there, at least when it is hungry. But what does the rat *think* when it is learning to turn right?

Does it seem absurd to try to place yourself in the "mind" of a rat? So it seemed to John Broadus Watson (1878–1958), the founder of American behaviorism. Watson was asked to consider the contents of a rat's "mind" as one of the requirements for his doctoral degree, which he received from the University of Chicago in 1903. Functionalism was the dominant view of psychology at the University of Chicago, and functionalists were concerned with the stream of consciousness as well as observable behavior. But Watson (1913) believed that if psychology were to be a natural science, like physics or chemistry, it must limit itself to observable, measurable events—that is, to behavior alone; hence the term *behaviorism*.

Behaviorism is the school of psychology that focuses on learning observable behavior. The term *observable* refers to behaviors that are observable by means of specialized instruments, such as heart rate, blood pressure, and brain waves. These behaviors are *public*—they can be measured easily and different observers would agree about their existence and features. Given their focus on behavior, behaviorists define psychology as the scientific study of *behavior*, not of *behavior and mental processes*.

B. F. Skinner (1904–1990) also contributed to behaviorism. He believed that organisms learn to behave in certain ways because they have been **reinforced** for doing so—that is, their behavior has a positive outcome. He demonstrated that laboratory animals can be trained to carry out behaviors through strategic use of reinforcers, such as food. He trained rats to turn in circles, climb ladders, and push toys across the floor. Because Skinner demonstrated that remarkable combinations of behaviors could be taught by means of reinforcement, many psychologists adopted the view that, in principle, one could

functionalism the school of psychology that emphasizes the uses or functions of the mind rather than the elements of experience

behaviorism the school of psychology that defines psychology as the study of observable behavior and studies relationships between stimuli and responses

reinforcement a stimulus that follows a response and increases the frequency of the response

FIG. 1.2 THE POWER OF REINFORCEMENT

Tom McHugh/Science Source

Behaviorists have shown that we can teach animals (and people) complex behaviors by first reinforcing approximations to the goal or target behavior. For example, we might first drop a food pellet into our feathered friend's cage when she drops the star anywhere on the tray, and then demand closer tries before reinforcing her. With people, of course, we can reinforce desired behavior by saying things like "Good," "That's right," or "You're getting there."

explain complex human behavior as the sum of countless instances of learning through reinforcement (see Figure 1.2).

1-2d GESTALT PSYCHOLOGY

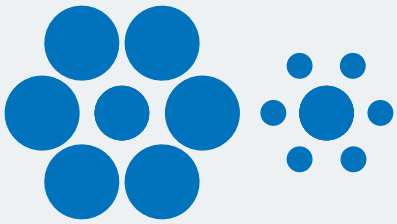
In the 1920s, another school of psychology—**Gestalt psychology**—was prominent in Germany. In the 1930s, the three founders of the school—Max Wertheimer (1880–1943), Kurt Koffka (1886–1941), and Wolfgang Köhler (1887–1967)—left Europe to escape the Nazi threat. They carried on their work in the United States, giving further impetus to the growing American ascendance in psychology.

Gestalt psychologists focused on perception and how perception influences thinking and problem solving. The German word *Gestalt* translates roughly to "pattern" or "organized whole." In contrast to behaviorists, Gestalt psychologists argued that we cannot hope to understand human nature by focusing only on overt behavior. In contrast to structuralists, they claimed that we cannot explain human perceptions, emotions, or thought processes in terms of basic units. Perceptions are *more* than the sums of their parts: Gestalt psychologists saw our perceptions as wholes that give meaning to parts, as we see in Figure 1.3.

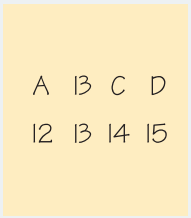
Gestalt psychology
the school of psychology that emphasizes the tendency to organize perceptions into wholes and to integrate separate stimuli into meaningful patterns

Gestalt psychologists showed that we tend to perceive separate pieces of information as integrated wholes depending on the contexts in which they occur. In Figure 1.3A, the dots in the centers of the configurations are the same size, yet we may perceive them as being different in size because of their surroundings. The second symbol in each line in Figure 1.3B is

FIG. 1.3 GESTALT PSYCHOLOGY AND THE IMPORTANCE OF CONTEXT



A. Are the dots in the center of the configurations the same size? Why not take a ruler and measure them?



B. Is the second symbol in each line the letter *B* or the number *13*?

C. Which of the gray squares is brighter?

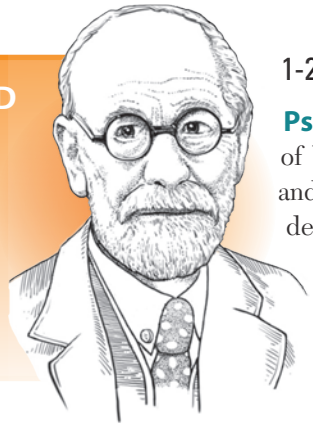
Gestalt psychologists have shown that we tend to interpret objects and people according to their context. You interpret somebody's running toward you differently when you are in a dark alley or watching a football game.

identical, but in the top row we may perceive it as a *B* and in the bottom row as the number *13*. The symbol has not changed, but its context has. The inner squares in Figure 1.3C are equally bright, but they do not appear so because of their contrasting backgrounds.

Gestalt psychologists believed that learning could be active and purposeful, not merely responsive and mechanical as in Watson's and Skinner's experiments. They demonstrated that much learning, especially in problem solving, is accomplished by insight, not by mechanical repetition.

Consider Köhler's classic research with chimpanzees, as shown in Figure 1.4. At first, the chimp is unsuccessful in reaching bananas suspended from the ceiling. Then it suddenly stacks the boxes and climbs up to reach the bananas. It seems the chimp has experienced a sudden reorganization of the mental elements of the problem—that is, he has had a "flash of insight." Köhler's findings suggest that we often manipulate the elements of problems until we group them in such a way that we can reach a goal. The manipulations may take quite some time as mental trial and error proceeds. But once the proper grouping has been found, we seem to perceive it all of a sudden.

SIGMUND FREUD



Sigmund Freud, the founder of psychoanalysis, is often the first person that comes to mind when people are asked to name a psychologist.

1-2e PSYCHOANALYSIS

Psychoanalysis is the name of both the theory of personality and the method of psychotherapy developed by Sigmund Freud (1856–1939). As a theory of personality, psychoanalysis proposes that much of our lives is governed by unconscious ideas and impulses that originate in childhood conflicts.

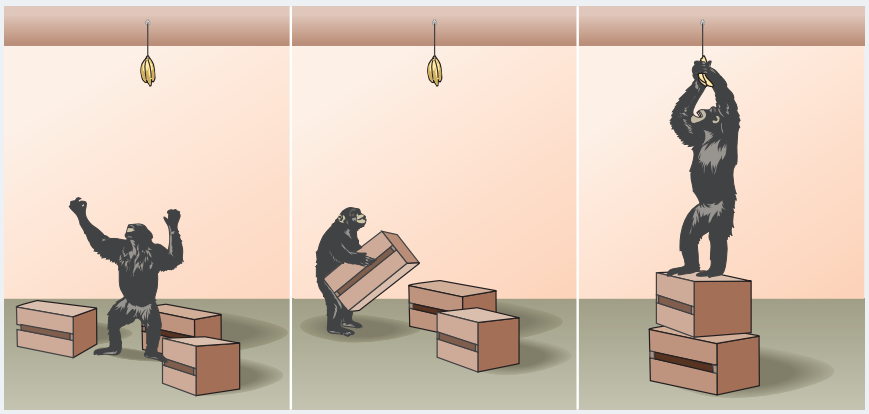
As a method of psychotherapy, psychoanalysis aims to help patients gain insight into their conflicts and to find socially acceptable ways of expressing wishes and gratifying needs. We'll put psychoanalysis on the couch in Chapter 10. (That is, we'll discuss psychoanalysis in more depth.)

1-3 CONTEMPORARY PERSPECTIVES IN PSYCHOLOGY

Today, we no longer find psychologists who describe themselves as structuralists or functionalists. Although the school of Gestalt psychology gave birth to current research approaches in perception and problem solving, few would label themselves Gestalt psychologists. But we do find Gestalt *therapists* who focus on helping clients integrate conflicting parts of their personality (making themselves "whole"). The numbers of orthodox behaviorists and psychoanalysts have been declining (Henley, 2019; Robins et al., 1999). Many contemporary psychologists in the behaviorist tradition look on themselves as social cognitive theorists, who see much of human learning as intentional rather than mechanical.

The history of psychological thought has taken many turns, and contemporary psychologists differ in their approaches. Today, there are several broad,

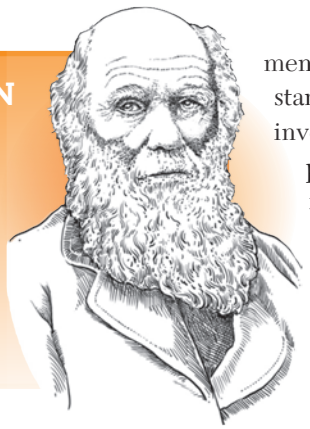
FIG. 1.4 GESTALT PSYCHOLOGY: SOME INSIGHT INTO INSIGHT



Have you ever had an "a-ha" experience? The chimpanzee from Köhler's research is shown here having just such an experience. At first, it cannot reach the bananas hanging from the ceiling. After some time has passed, it has an apparent "flash of insight" and rapidly piles the boxes on top of one another to reach the fruit.

psychoanalysis the school of psychology that emphasizes the importance of unconscious motives and conflicts as determinants of human behavior

influential perspectives in psychology: biological, cognitive, humanistic–existential, psychodynamic, learning, and sociocultural. Each approaches its topics in its own way.



CHARLES DARWIN

In the mid-19th century, British naturalist Charles Darwin presented his theory that the animal and plant species that occupy the world today—including *Homo sapiens* (us)—have evolved from earlier species.

1-3a THE BIOLOGICAL PERSPECTIVE

Psychologists with a **biological perspective** seek the relationships between the brain, hormones, heredity, and evolution, on the one hand, and behavior and mental processes, on the other. Psychologists assume that thoughts, fantasies, and dreams—and the inborn or instinctive behavior patterns of various species—are made possible by the nervous system and especially by the brain.

Biologically oriented psychologists also study the role of heredity in behavior and mental processes such as psychological disorders, criminal behavior, and thinking. Generally speaking, our heredity provides a broad range of behavioral and mental possibilities. Environmental factors interact with inherited factors to determine specific behavior and mental processes.

Biologically oriented psychologists focus on the evolution of behavior and mental processes as well. Darwin argued that in the age-old struggle for existence, only the fittest (most adaptive) organisms manage to reach maturity and reproduce. For example, fish that swim faster or people who are naturally immune to certain diseases are more likely to survive and transmit their genes to future generations. Therefore, species tend to evolve in adaptive directions. Evolutionary psychologists suggest that much human social behavior, such as aggressive behavior and mate selection, has a hereditary basis. People may be influenced by social rules, cultural factors, and personal choice, but evolutionary psychologists believe that inherited tendencies sort of whisper in people's ears and tend to move them in certain directions.

biological perspective the approach to psychology that seeks to understand the nature of the links between biological processes and structures such as the functioning of the brain, the endocrine system, and heredity, on the one hand, and behavior and mental processes, on the other

cognitive having to do with mental processes such as sensation and perception, memory, intelligence, language, thought, and problem solving

1-3b THE COGNITIVE PERSPECTIVE

Psychologists with a **cognitive** perspective venture into the realm of mental processes to understand human nature. They investigate the ways we perceive and mentally represent the world, how we learn, remember the past, plan for the future, solve problems, form judgments, make decisions, and use language. Cognitive psychologists, in short, study those things we refer to as the *mind*.

The cognitive tradition has roots in Socrates's advice to "Know thyself" and in his suggested method of introspection. We also find cognitive psychology's roots in structuralism, functionalism, and Gestalt psychology, each of which, in its own way, addresses issues that are of interest to cognitive psychologists.

1-3c THE HUMANISTIC–EXISTENTIAL PERSPECTIVE

The humanistic–existential perspective is cognitive in flavor, yet it emphasizes the role of subjective (personal) experience. Let's consider each of the parts of this perspective: humanism and existentialism.

Humanism stresses the human capacity for self-fulfillment and the central roles of consciousness, self-awareness, and decision making. Humanists believe that self-awareness, experience, and choice permit us, to a large extent, to "invent ourselves" and our ways of relating to the world as we progress through life. Consciousness—our sense of being in the world—is seen as the force that unifies our personalities. *Existentialism* views people as free to choose and as being responsible for choosing ethical conduct. Grounded in the work of Carl Rogers (1951) and Abraham Maslow (1970), the humanistic–existential perspective has many contemporary adherents.

1-3d THE PSYCHODYNAMIC PERSPECTIVE

In the 1940s and 1950s, psychodynamic theory dominated the practice of psychotherapy and was influential in scientific psychology and the arts. Most psychotherapists were psychodynamically oriented. Many renowned artists and writers consulted psychodynamic therapists as a way to liberate the expression of their unconscious ideas. Today, Freud's influence continues to be felt, although it no longer dominates psychotherapy. Contemporary psychologists who follow theories derived from Freud are

likely to call themselves *neoanalysts*. Famous neoanalysts such as Karen Horney (1885–1952) and Erik Erikson (1902–1994) focused less on unconscious processes and more on conscious choice and self-direction.

1-3e PERSPECTIVES ON LEARNING

Many contemporary psychologists study the effects of experience on behavior. Learning, to them, is the essential factor in describing, explaining, predicting, and controlling behavior. The term *learning* has different meanings to psychologists of different persuasions, however. Some students of learning find roles for consciousness and insight. Others do not. This distinction is found today among those who adhere to the behavioral and social cognitive perspectives.

Early proponents of behaviorism, such as John B. Watson, viewed people as doing things because of their learning histories, their situations, and rewards, not because of conscious choice. Like Watson, contemporary behaviorists emphasize environmental influences and the learning of habits through repetition and reinforcement. **Social cognitive theorists**, in contrast, suggest that people can modify and create their environments. They also grant *cognition* a key role. They note that people engage in intentional learning by observing others. Since the 1960s, social cognitive theorists have gained prominence in the areas of personality development, psychological disorders, psychotherapy, and even career development (Hui et al., 2018).

1-3f THE SOCIOCULTURAL PERSPECTIVE

The profession of psychology focuses mainly on the individual and is committed to the dignity of the individual. However, many psychologists believe we cannot understand people's behavior and mental processes without reference to their diversity (Miville et al., 2016).

The **sociocultural perspective** addresses many of the ways that people differ from one another. It studies the influences of ethnicity, gender, culture, and socioeconomic status on behavior and mental processes (Comas-Diaz & Greene, 2013). For example, what is often seen as healthful, self-assertive, outspoken behavior by most U.S. women may be interpreted as brazen behavior in Latin American or Asian American communities.

David Buffington/Photodisc/Getty Images

Psychologists focus on the individual but believe that we cannot understand individuals without referring to their diversity, such as their gender, their ethnic backgrounds, and their physical condition.

ETHNICITY One kind of diversity involves ethnicity. Members of an *ethnic group* share their cultural heritage, race, language, or history. The experiences of various ethnic groups in the United States highlight the impact of social, political, and economic factors on human behavior and development (Jones, 2019).

In the 1940s, Kenneth Bancroft Clark (1914–2005) and Mamie Phipps Clark (1917–1983) conducted research that showed the negative effects of school segregation on African American children. In one such study, African American children were shown white and

social cognitive theory
the school of psychology in the behaviorist tradition that includes cognitive factors in the explanation and prediction of behavior; formerly termed *social learning theory*

sociocultural perspective
the view that focuses on the roles of ethnicity, gender, culture, and socioeconomic status in behavior and mental processes

brown dolls and were asked to "Give me the pretty doll" or "Give me the doll that looks bad." Most children's choices showed that they preferred the white dolls to the brown ones. The Clarks (1950) concluded that the children had accepted the larger society's prejudiced views that favored European Americans. The Clarks' research was cited by the Supreme Court in 1954 when it overturned the "separate but equal" schools doctrine that had allowed inequalities in school services for ethnic minorities.

Latin American and Asian American psychologists have also made their mark. Jorge Sanchez was among the first to show how intelligence tests are culturally biased—to the disadvantage of Mexican American children. Latina American psychologist Lillian Comas-Diaz (2017) has edited a journal on multicultural mental health. Asian American psychologists Richard M. Suinn (2010) and Frederick Leong (2016; Leong et al., 2018) study mental health and the development of identity among Asians and Asian Americans.

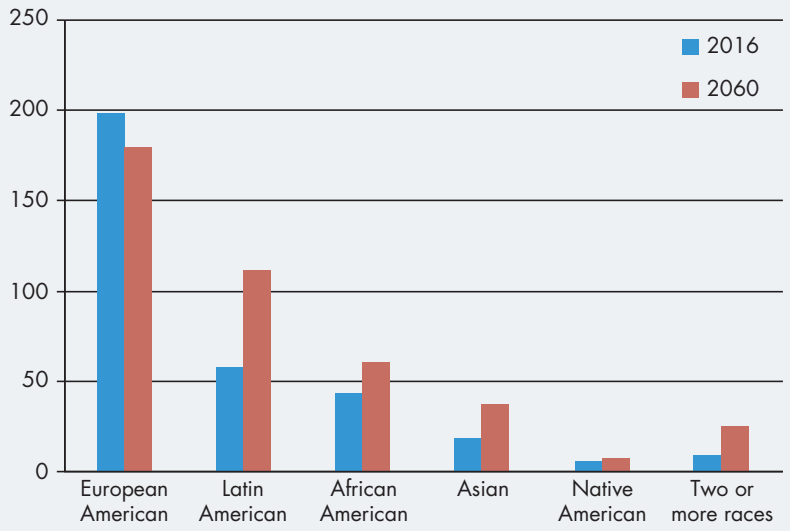
The roles of ethnicity and race grow more important in psychology as the nation diversifies. Figure 1.5 compares the 2016 racial makeup of the United States with the projected racial makeup in 2060.

As time goes on, the profession of psychology will more likely reflect the diversity in the nation. For example, Figure 1.1 shows that the percentage of psychologists from ethnic minorities is higher among psychologists with new doctorates than among American Psychological Association (APA) members, who include psychologists from older generations.

GENDER **Gender** refers to the culturally defined concepts of *masculinity* and *femininity*. Gender is not fully defined by anatomic sex. It involves a complex web of cultural expectations and social roles that affect people's self-concepts and hopes and dreams as well as their behavior. Just as members of ethnic-minority groups have experienced prejudice, so too have women.

gender the culturally defined concepts of *masculinity* and *femininity*

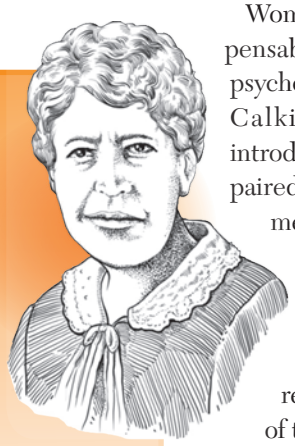
FIG. 1.5 RACIAL MAKEUP OF THE UNITED STATES IN MILLIONS, 2016 AND 2060 (PROJECTED)



Source: Vespa, J., Armstrong, D. M., & Medina, L. (2018). *Demographic turning points for the United States: Population projections for 2020 to 2060*. U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau.

Although American women have attended college only since 1833, when Oberlin College opened its doors to women, most American college students today are in fact women. Women APA members outnumber male APA members (refer back to Figure 1.1), and their numbers are growing dramatically, as shown by the percentage of new doctorates received by women (APA, 2009, 2014). Today 65% of all psychologists are women (Lin et al., 2019).

MARY WHITON CALKINS



At a time when men dominated the discipline of psychology, Mary Whiton Calkins was one of the pioneers who fought the male-centered bias and encouraged psychology to incorporate the values of the "new woman" (Rogers, 2009). She pioneered research in memory at Wellesley College, where she founded a psychology laboratory in 1891. She introduced the method of paired associates, discovered the primacy and recency effects, and engaged in research into the role of the frequency of repetition in the vividness of memories.

Women have made indispensable contributions to psychology. Mary Whiton Calkins (1863–1930) introduced the method of paired associates to study memory (see Chapter 7), discovered the primacy and recency effects, and engaged in research into the role of the frequency of repetition in the vividness of memories. Calkins had studied psychology at Harvard University, which she had to attend

as a "guest student" because Harvard was not yet admitting women. When she completed her PhD requirements, Harvard would not award her the degree because of her sex. Instead, Harvard offered to grant her a doctorate from its sister school, Radcliffe. As a form of protest, Calkins declined the offer. Even without the PhD, Calkins became president of the American Psychological Association.

In more recent years, Mary Salter Ainsworth (1913–1999) revolutionized our understanding of attachment between parents and children by means of her cross-cultural studies. Elizabeth Loftus (2017) has shown that our memories are not snapshots of the past. Instead, they often consist of something old (what actually happened), something new (i.e., influenced by more recent events), something borrowed (e.g., further shaped by our biases and prejudices), and something blue (altered by tinges of color or emotion).

> Our memories are not pure snapshots of the past. Instead, they often consist of *something old* (what actually happened), *something new* (that is, they are influenced by more recent events), *something borrowed* (they are further shaped by our biases and prejudices), *and something blue* (they can be altered by tinges of color or emotion).

The contributions of members of diverse ethnic groups and women have broadened our understanding of the influences of ethnicity and gender on behavior and mental processes. They have also increased our knowledge of differences among Europeans. For example, southern European singles (from Italy, Greece, and Portugal) are more likely than northern European singles (from the United Kingdom, France, Germany, and Scandinavia) to live with their parents until they get married (Giuliano, 2007). The researcher suggests that the family ties and religious traditions of southern Europeans seem to be relatively stronger.

TRUTH

It is **true** that the first female president of the American Psychological Association, Mary Whiton Calkins, turned down the doctoral degree that was offered to her by Radcliffe. Radcliffe was Harvard University's "sister school," and she rejected the sexism that was preventing her from receiving the degree that she had actually earned at Harvard.

1-4 HOW PSYCHOLOGISTS STUDY BEHAVIOR AND MENTAL PROCESSES

Does alcohol cause aggression? Does watching violence on television cause children to be violent? Why do some people hardly ever think of food, whereas others are obsessed with it and snack all day? Why are women more likely than men to be depressed? Why do some unhappy people attempt suicide, whereas others don't? Does having people of different ethnic backgrounds collaborate in their work affect feelings of prejudice?

Many of us have expressed opinions—and sometimes strong opinions—on questions like these. But as we saw in our discussion of people who claim to be abducted by aliens from outer space, scientists insist on evidence. Psychologists, as other scientists, use careful means to observe and measure behavior and the factors that influence behavior.

Psychologists use the scientific method to decide what kind of evidence they need and how to pursue it. They also select the population they intend to study, such as U.S. teenagers or older adults, and try to obtain a sample that represents that population.

1-4a THE SCIENTIFIC METHOD

The **scientific method** is an organized way of using experience and testing ideas to expand and refine knowledge. Psychologists do not necessarily follow the steps of the scientific method as we might follow a recipe in a cookbook, but research is guided by certain principles.

scientific method an organized way of using experience and testing ideas to expand and refine knowledge

Psychologists usually begin by *formulating a research question*. Research questions can have many sources. Our daily experiences, psychological theory, and even folklore all help generate questions for research. Daily experience in using daycare centers may motivate us to conduct research on whether daycare affects the development of social skills or the bonds of attachment between children and their parents. Social cognitive principles of observational learning may prompt research on the effects of television violence. Research questions may also arise from common knowledge. Consider familiar adages such as "misery loves company" and "opposites attract." Psychologists may ask: *Does* misery love company? *Do* opposites attract?

A research question may be studied as a question or reworded as a *hypothesis* (see Figure 1.6). A **hypothesis** is a statement about behavior or mental processes that is testable through research. A hypothesis about daycare might be that preschoolers who are placed in daycare will acquire greater social skills in relating to peers than preschoolers who are cared for in the home.

Psychologists next examine the research question or *test the hypothesis* through controlled methods such as the experiment. For example, we could take a group of preschoolers who attend daycare and another group who do not and introduce each to a new child in a controlled setting such as a child-research center. We could then observe how children in each group interact with the new acquaintance.

Psychologists draw conclusions about their research questions or the accuracy of their hypotheses on the basis of their observations or findings. When their observations do not bear out their hypotheses, they may modify the theories from which the hypotheses were derived. Research findings often suggest refinements to psychological theories and new avenues of research. In our research on daycare, we might find that children in daycare do show greater social skills than children who are cared for in the home (Belsky et al., 2001; Broekhuizen et al., 2016).

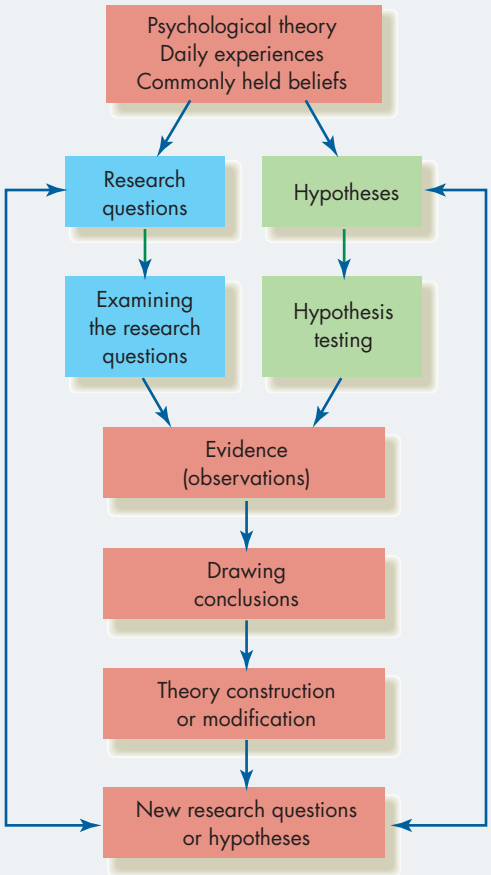
As psychologists draw conclusions from research evidence, they are guided by principles of critical thinking. For example, they try not to confuse **correlations**—or associations—between findings with cause and effect. Although more aggressive children apparently spend more time watching violent television shows, it may be erroneous to conclude from this kind of evidence that television violence *causes* aggressive behavior. A **selection factor** may be at work because the children being studied choose (select) for themselves what they will watch. Perhaps more aggressive children are more likely than less aggressive children to tune in to violent television shows.

hypothesis in psychology, a specific statement about behavior or mental processes that is tested through research

correlation an association or a relationship among variables, as we might find between height and weight or between study habits and school grades

selection factor a source of bias that may occur in research findings when participants are allowed to choose for themselves a certain treatment in a scientific study

FIG. 1.6 THE SCIENTIFIC METHOD



The scientific method is a systematic way of organizing and expanding scientific knowledge.

1-4b SAMPLES AND POPULATIONS

Consider a piece of history that never quite happened: The Republican candidate Alf Landon defeated the incumbent president, Franklin D. Roosevelt, in 1936. Or at least Landon did so in a poll conducted by a popular magazine of the day, the *Literary Digest*. In the actual election, however, Roosevelt routed Landon by a landslide. How was so great a discrepancy possible?

The *Literary Digest*, you see, had surveyed voters by phone. Today, telephone sampling is still widely practiced, but the *Literary Digest* poll was taken during the Great Depression, when people who had telephones were much wealthier than those who did not. People at higher income levels were also more likely to vote Republican, in this case, for Landon. Question: Is telephone sampling valid if it omits some people—such as a number of college students!—whose only telephone is a cellphone?

TRUTH

It is **true** that you could survey millions of voters and still not predict the outcome of a presidential election. Samples must be representative; size alone may not matter.

The *Literary Digest* poll failed because of its method of sampling. A **sample** is a segment of a **population** that must be drawn so that it accurately *represents* that population. Only representative samples allow us to *generalize*—or *extend*—our findings from research samples to target populations, such as U.S. voters, and not subgroups such as Southern Californians or Asian American members of the middle class.

Fuse/Getty Images

The Importance of Sample Selection
You may ask 20,000 people like this who they will vote for in the U.S. presidential election, but it will probably not help you determine the winner. If you interview people who are older, who have enough money to risk losing it, and who are white, your results will tend to lean right in terms of political opinions. In order to make your prediction, you need to sample people who represent the target population—that is, Americans of all ages, income levels, and ethnic/racial backgrounds.

1-4c PROBLEMS IN GENERALIZING FROM PSYCHOLOGICAL RESEARCH

Many factors must be considered when interpreting the accuracy of the results of scientific research. One is the nature of the research sample. Later in the chapter, we consider research in which the participants were drawn from a population of college men who were social drinkers. That is, they tended to drink at social gatherings but not when alone. Who do college men represent other than themselves? To whom can we extend, or generalize, the results? For one thing, they do not extend to college women, who, as we see in Chapter 4, are affected more quickly than men by alcohol.

> "All generalizations are dangerous, even this one."
>
> *Alexandre Dumas*

Also, compared to the general adult male population, college men are younger and score higher on intelligence tests. Social drinkers may also differ biologically and psychologically from people who have difficulty controlling their drinking.

By and large, we must also question whether findings of research with men can be generalized to women and whether research with European American men can be extended to members of ethnic minority groups.

RANDOM AND STRATIFIED SAMPLING One way to achieve a representative sample is by means of random sampling. In a **random sample**, each member of a population has an equal chance of being selected to participate. Researchers can also use a **stratified sample**, which is selected so that identified subgroups in the population are represented proportionately in the sample. For instance, 13% of the American population is African American. A stratified sample would thus be

sample part of a population

population a complete group of interest to researchers, from which a sample is drawn

random sample a sample drawn so that each member of a population has an equal chance of being selected to participate

stratified sample a sample drawn so that identified subgroups in the population are represented proportionately in the sample

13% African American. As a practical matter, a large randomly selected sample will show reasonably accurate stratification. A random sample of 1,500 people will represent the broad American population reasonably well. However, a sample of 20,000 European Americans or men will not.

Large-scale magazine surveys of sexual behavior ask readers to fill out and return questionnaires. Although many thousands of readers complete the questionnaires and send them in, do the survey respondents represent the American population? Probably not. These and similar studies may be influenced by **volunteer bias**. People who offer or volunteer to participate in research studies differ systematically from people who do not. In the case of research on sexual behavior, volunteers may represent subgroups of the population—or of readers of the magazines in question—who are willing to disclose intimate information and therefore may also be likely to be more liberal in their sexual behavior (Hendrickx et al., 2018; Sedgwick, 2015). Volunteers may also be more interested in research than other people, as well as have more spare time. How might such volunteers differ from the population at large? How might such differences slant or bias the research outcomes?

1-5 METHODS OF RESEARCH

Many people consider themselves experts on behavior and mental processes. How many times, for example, have you or someone else been eager to share a life experience that proves some point about human nature?

We see much during our lifetimes, but our personal observations tend to be fleeting and unsystematic. We sift through experience for the things that interest us. We often ignore the obvious because it does not fit our assumptions about the way things ought to be. Scientists, however, have devised more controlled ways of studying others.

volunteer bias a source of bias or error in research reflecting the prospect that people who offer to participate in research studies differ systematically from people who do not

case study a carefully drawn biography that may be obtained through interviews, questionnaires, and psychological tests

1-5a METHODS OF OBSERVATION

Nearly all kinds of psychological research involve observation of the behavior of samples of populations. But some methods—the case study, the survey, and naturalistic observation—are mainly descriptive in nature.

THE CASE STUDY **Case studies** collect information about individuals and small groups. Many case studies are clinical; that is, they are descriptions of a person's psychological problems and how a psychologist treated them. Case studies are sometimes used to investigate rare occurrences, as in the case of Chris Sizemore, who was diagnosed with dissociative identity disorder ("multiple personalities"). A psychiatrist identified three distinct personalities in Chris. Her story was made into a movie called *The Three Faces of Eve* (a fictitious name). One personality, "Eve White," was a mousy, well-meaning woman. "Eve Black," a flirtatious and promiscuous personality, sometimes emerged and took control of Eve. A third personality, "Jane," was well adjusted and integrated parts of the personalities of the Eves.

Moviestore collection Ltd / Alamy Stock Photo

The Three Faces of Eve
The movie, starring Joanne Woodward, was a fascinating case study into the life of Chris Sizemore, a woman who was diagnosed with dissociative identity disorder ("multiple personalities"). As the story progressed in the film, the core character managed to integrate the various parts of her personality into one.

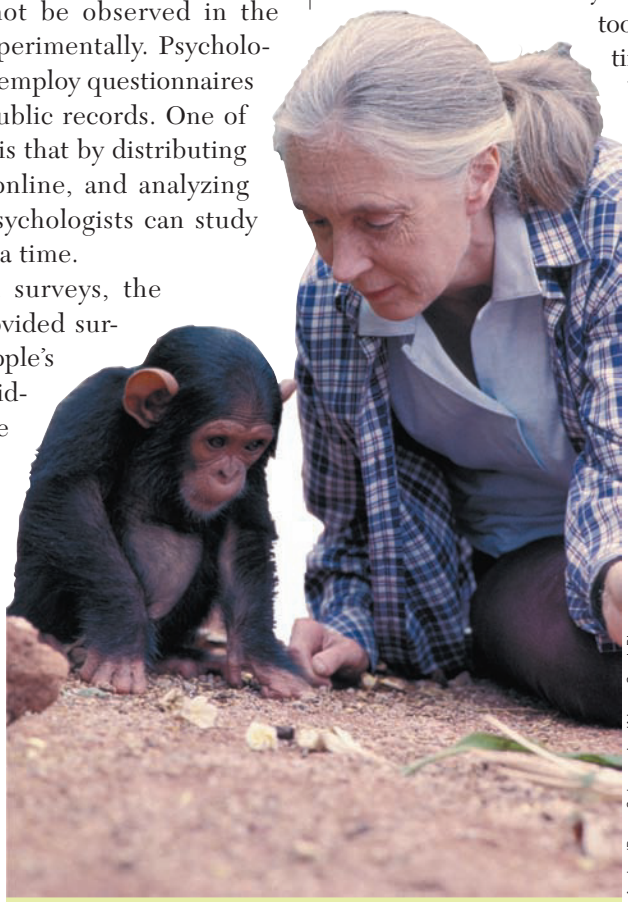
Case studies are subject to inaccuracies. We find gaps and factual errors in people's memories (Loftus, 2017). People may also distort their pasts to please or to antagonize the interviewer. Interviewers may also have certain expectations and may subtly encourage participants to fill in gaps in ways that are consistent with these expectations. Psychoanalysts, for example, have been criticized for guiding people who seek their help into viewing their own lives from the psychodynamic perspective (Henley, 2019). No wonder, then, that many people provide "evidence" that is consistent with psychodynamic theory—such as suggesting that their parents' inept handling of their toilet training is the source of their compulsive neatness. However, interviewers of *any* theoretical viewpoint may subtly prod people into saying what they want to hear.

THE SURVEY Just as computers and pollsters predict election results and report national opinion on the basis of scientifically selected samples, psychologists conduct **surveys** to learn about behavior and mental processes that cannot be observed in the natural setting or studied experimentally. Psychologists conducting surveys may employ questionnaires and interviews or examine public records. One of the advantages of the survey is that by distributing questionnaires, sometimes online, and analyzing answers with a computer, psychologists can study many thousands of people at a time.

One of the best-known surveys, the so-called Kinsey reports, provided surprising information about people's sexual behavior during the middle of the 20th century, a time of widespread sexual repression in the United States. Alfred Kinsey and his colleagues published two surveys of sexual behavior, based on interviews: *Sexual Behavior in the Human Male* (1948) and *Sexual Behavior in the Human Female* (1953). The nation was shocked to hear that masturbation was virtually universal in his sample of men in a day when masturbation was still widely thought to impair health. At the time, it was also widely believed that nearly all single women were virgins. Yet Kinsey found that about one woman in three who remained single at age 25 reported having engaged in sexual intercourse. We report more valid information on current American sexual behavior in Chapter 8.

Surveys, like case studies, also have sources of inaccuracy (Camburn et al., 2017). People may recall their behavior inaccurately or deny or lie about it. Some people try to ingratiate themselves with their interviewers by answering in a socially desirable direction. The Kinsey studies all relied on male interviewers, and it has been speculated that female interviewees might have been more open with female interviewers. Similar problems may occur when interviewers and the people surveyed are from different ethnic or socioeconomic backgrounds. Other people may falsify attitudes and exaggerate problems to draw attention to themselves or to intentionally foul up the results.

Consider some survey errors caused by inaccurate self-reports of behavior. If people brushed their teeth as often as they claimed and used the amount of toothpaste they indicated, three times as much toothpaste would be sold in the United States as is actually sold (Koerber et al., 2006). People also overreport the extent to which they follow doctors' orders (Wilson et al., 2009) and underreport how much they smoke (Liber & Warner, 2018). Why do you think this is so?



Avalon/Bruce Coleman Inc/Alamy Stock Photo

Naturalistic Observation
Jane Goodall's naturalistic observations revealed that chimpanzees—like humans—use tools and greet one another with a kiss.

NATURALISTIC OBSERVATION You use **naturalistic observation**—that is, you observe people in their natural habitats—every day. Naturalistic observation allows psychologists and other scientists to observe behavior where it happens, or "in the

survey a method of scientific investigation in which a large sample of people answer questions about their attitudes or behavior

naturalistic observation a scientific method in which organisms are observed in their natural environments

field." Observers use unobtrusive measures to avoid interfering with the behaviors they are observing. For example, Jane Goodall has observed the behavior of chimpanzees in their natural environment to learn about their social behavior, sexual behavior, and use of tools and other facts of chimp life (Goodall & Pusey, 2016). Her observations have shown us that (1) we were incorrect to think that only humans use tools and (2) kissing on the lips, as a greeting, is used by chimps as well as humans.

1-5b CORRELATION

Once psychologists have observed the behavior of their samples, they often use correlation to try to answer such questions as, Are people with higher intelligence test scores more likely to obtain good grades in school? Are people with a stronger need for achievement likely to climb higher up the corporate ladder? What is the relationship between stress and health?

Correlation follows observation. By using the **correlational method**, psychologists investigate whether observed behavior or a measured trait is related to, or correlated with, another. Consider the variables of intelligence and academic performance. These variables are assigned numbers such as intelligence test scores and academic averages. Then the numbers are mathematically related and expressed as a **correlation coefficient** (r). A correlation coefficient is a number that varies from $r = +1.00$ to $r = -1.00$.

Studies report *positive correlations* between intelligence test scores and academic achievement, as measured, for example, by grade point averages. That is, the higher people score on intelligence tests, the better their academic performance is likely to be. Intelligence test scores tend to be positively correlated (about $r = +0.30$ to $r = +0.60$) with academic achievement (see Figure 1.7). But factors *other* than performance on intelligence tests also contribute to academic success. These include early learning opportunities, desire to get ahead, self-discipline, ability to manage stress, and belief in one's ability to succeed (Nisbett, 2011; Ray et al., 2016; Williams et al., 2017).

Correlations may also be *negative*; that is, as one variable increases, the other variable decreases. For example, there is a negative correlation between stress and health. As the amount of stress affecting us increases, the functioning of our immune system decreases. As a result, under high levels of stress, many people show poorer health.

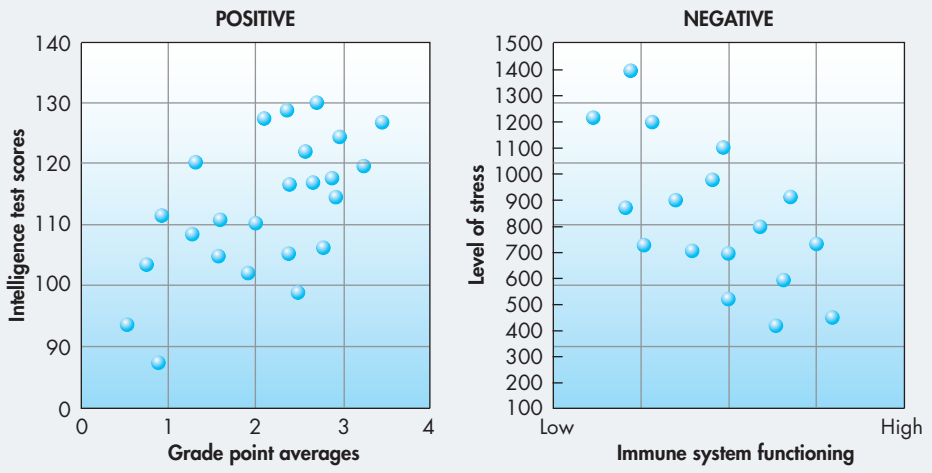
What kinds of correlations (positive or negative) would you expect to find among behavior patterns such as the following: Churchgoing and crime? Language ability and musical ability? Grades in school and delinquency? Why?

Correlational research may suggest, but does not prove, cause and effect. For example, it may seem logical to assume that high intelligence makes it possible for children to profit from education. However, research has also shown that education contributes to higher scores on

correlational method
a mathematical method of determining whether one variable increases or decreases as another variable increases or decreases

correlation coefficient
a number between +1.00 and −1.00 that expresses the strength and direction (positive or negative) of the relationship between two variables

FIG. 1.7 CORRELATIONS



Positive correlation, as found between intelligence test scores and academic achievement

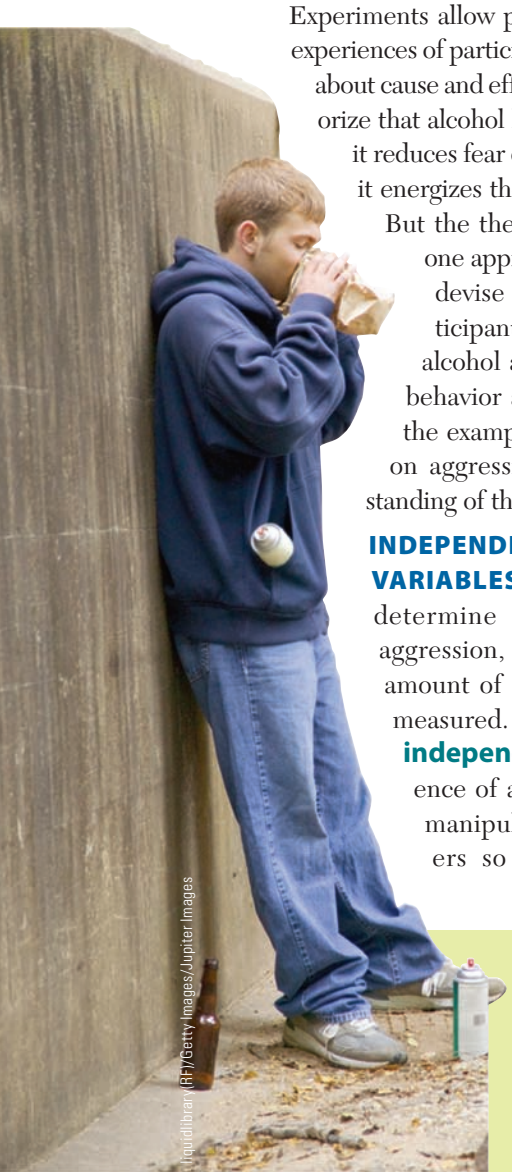
Negative correlation, as found between stress and functioning of the immune system

When there is a positive correlation between variables, as there is between intelligence test scores and achievement, one increases as the other increases. By and large, the higher people score on intelligence tests, the better their academic performance is likely to be, as in the diagram on the left. (Each dot represents an individual's intelligence test score and grade point average.) But there is a negative correlation between stress and health. As the amount of stress we experience increases, the functioning of our immune system tends to decrease.

intelligence tests (Nisbett, 2009, 2011). Preschoolers who are placed in stimulating Head Start programs later attain higher scores on intelligence tests than agemates who did not have this experience. What of the link between stress and health? Does stress impair health, or is it possible that people in poorer health encounter more stress?

1-5c THE EXPERIMENTAL METHOD

The preferred method for answering questions about cause and effect is the experiment. In an **experiment**, a group of participants obtains a treatment, such as a dose of alcohol, a change in room temperature, or perhaps an injection of a drug. The participants are then observed to determine whether the treatment makes a difference in their behavior. Does alcohol alter the ability to take tests, for example? What are the effects of differences in room temperatures and the level of background noise?


liquidlibrary (RF)/Getty Images/Jupiter Images

What kind of correlation would you expect to find between teenagers' grades in school and their numbers of delinquent acts? Why?

Experiments allow psychologists to control the experiences of participants and draw conclusions about cause and effect. A psychologist may theorize that alcohol leads to aggression because it reduces fear of consequences or because it energizes the activity levels of drinkers. But the theory needs to be tested. In one approach, the psychologist may devise a treatment in which participants receive various doses of alcohol and the outcomes on their behavior are measured. Let's follow the example of the effects of alcohol on aggression to further our understanding of the experimental method.

INDEPENDENT AND DEPENDENT VARIABLES In an experiment to determine whether alcohol causes aggression, participants are given an amount of alcohol and its effects are measured. In this case, alcohol is an **independent variable**. The presence of an independent variable is manipulated by the experimenters so that its effects may be determined. The independent variable of alcohol may be administered at different levels, or doses, from none or very little to enough to cause intoxication or drunkenness.

The measured results, or outcomes, in an experiment are called **dependent variables**. The presence of dependent variables presumably depends on the independent variables. In an experiment to determine whether alcohol influences aggression, aggressive behavior would be a dependent variable. Other dependent variables of interest might include sexual arousal, visual–motor coordination, and performance on cognitive tasks such as math problems.

In an experiment on the relationships between temperature and aggression, temperature would be an independent variable and aggressive behavior would be a dependent variable. We could set temperatures from below freezing to blistering hot and study the effects of these extremes on aggression. We could also use a second independent variable such as social provocation; we could insult some participants but not others and see whether insults affect their level of aggression. This method would allow us to study how two independent variables—temperature and social provocation—affect aggression, by themselves and together.

EXPERIMENTAL AND CONTROL GROUPS Ideal experiments use experimental groups and control groups. Participants in **experimental groups** obtain the treatment. Members of **control groups** do not. Every effort is made to ensure that all other conditions are held constant for both groups. This method enhances the researchers' confidence that the outcomes of the experiment are caused by the treatments and not by chance factors or chance fluctuations in behavior.

For example, in an experiment on the effects of alcohol on aggression, members of the experimental group would ingest alcohol, and members of the control group would not. The researcher would then measure how much aggression was shown by each group.

BLINDS AND DOUBLE BLINDS However, people tend to act in stereotypical ways when they have been drinking

experiment a scientific method that seeks to confirm cause-and-effect relationships by introducing independent variables and observing their effects on dependent variables

independent variable a condition in a scientific study that is manipulated so that its effects may be observed

dependent variables a measure of an assumed effect of an independent variable

experimental groups in experiments, groups whose members obtain the treatment

control groups in experiments, groups whose members do not obtain the treatment, while other conditions are held constant

alcohol (Greitemeyer & Nierula, 2016; Rich et al., 2015). For instance, men tend to become less anxious in social situations, more aggressive, and more sexually aroused. To what extent do these behavior patterns reflect the direct effects of alcohol on the body, and to what extent do they reflect people's beliefs about the effects of alcohol?

One experiment on the effects of alcohol on aggression (Boyatzis, 1974) reported that men at parties where beer and liquor were served acted more aggressively than men at parties where only soft drinks were served. But participants in the experimental group knew they had drunk alcohol, and those in the control group knew they had not. Aggression that appeared to result from alcohol might not have reflected drinking per se. Instead, it might have reflected the participants' expectations about the effects of alcohol. How do we control for the effects of participants' expectations?

TRUTH

It is **true** that neither the participants nor the researchers know who is receiving the real treatment in many experiments. This "double-blind" method controls for the effects of participants' and researchers' expectations.

In medicine, physicians sometimes give patients **placebos** (a fake treatment, such as sugar pills, that appears to be genuine) when the patient insists on having a medical cure but the physician does not believe that medicine is necessary. When patients report that placebos have helped them, it is because they expected the pills to be of help and not because of the biochemical effects of the pills. Placebos are not limited to sugar pills. Interestingly, the taste of vodka and tonic water is almost impossible to distinguish from tonic water alone. Therefore, tonic water can be used as a placebo in experiments on the effects of alcohol. Moreover, if participants believe they have drunk alcohol but have actually been given tonic water only, we may conclude that changes in their behavior result from their beliefs about the effects of alcohol and not from the alcohol itself.

Purestock/Getty Images

Well-designed experiments control for the effects of expectations by creating conditions under which participants are unaware of, or **blind** to, the treatment. Placebos are one way of keeping participants blind as to whether they have received a particular treatment. Yet researchers may also have expectations. They may be "rooting for" a certain treatment outcome, a phenomenon known as *experimenter bias*. For instance, tobacco company executives may wish to show that cigarette smoking is harmless. In such cases, it is useful if the people measuring the experimental outcomes are unaware of which participants have received the treatment. Studies in which neither the participants nor the experimenters know who has obtained the treatment are called **double-blind studies**.

Neither the participants nor the researchers know who is receiving the real treatment in many experiments. For example, the Food and Drug Administration requires double-blind studies before it allows the marketing of new drugs. The drug and the placebo look and taste alike. Experimenters assign the drug or placebo to participants at random. Neither the participants nor the observers know who is taking the drug and who is taking the placebo. After the final measurements have been made, a neutral panel (a group of people who have no personal stake in the outcome of the study) judges whether the effects of the drug differed from those of the placebo.

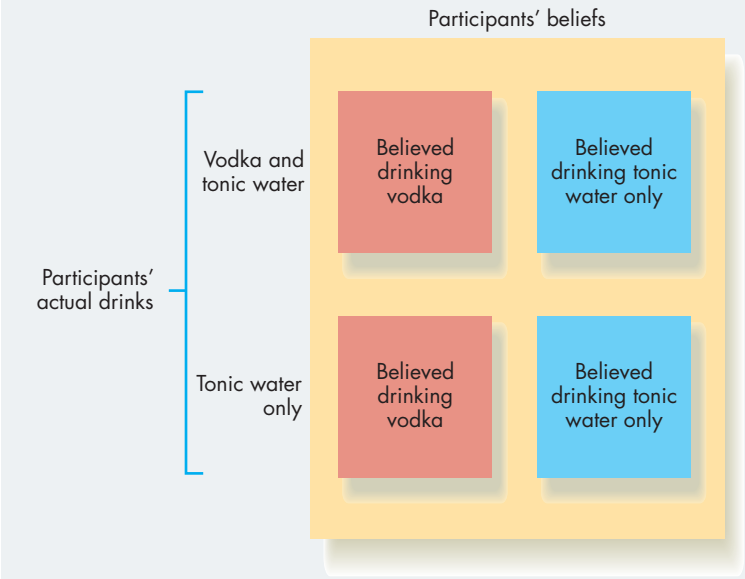
In an illustrative double-blind study on the effects of alcohol on aggression, Alan Lang and his colleagues (1975) pretested a highball of vodka and tonic water to determine that it could not be discriminated by taste from tonic water alone. They then recruited college men who described themselves as "social drinkers" to participate in the study. Some of the men drank vodka and tonic water. Others drank tonic water only. Of the men who drank vodka, half were misled into believing they had drunk tonic water only (see Figure 1.8). Of those who drank tonic water only, half were misled into believing their drink contained vodka. Thus, half the participants were blind to their treatment. Experimenters defined aggression as

placebo a bogus treatment that has the appearance of being genuine

blind in experimental terminology, unaware of whether or not one has received a treatment

double-blind study a study in which neither the subjects nor the observers know who has received the treatment

FIG. 1.8 THE SIGNIFICANCE OF DOUBLE-BLIND STUDIES



In the Lang study on alcohol and aggression, the subjects were kept "blind" as to whether or not they had actually drunk alcohol by using tonic water to mask the presence or absence of vodka. Blind studies allow psychologists to control for the effects of subjects' expectations.

pressing a lever that participants believed would deliver an electric shock to another person. The researchers who measured the men's aggressive responses were also blind concerning which participants had drunk vodka.

The research team found that men who believed that they had drunk vodka responded more aggressively (selected a higher level of shock) in response to a provocation than men who believed that they had drunk tonic water only. The actual content of the drink was immaterial. That is, the men's *belief* about what they drank affected their behavior more than what they actually consumed. The results of the Lang study differ dramatically from those reported by Boyatzis, perhaps because the Boyatzis study did not control for the effects of expectations or beliefs about alcohol.

1-6 CRITICAL THINKING

We have seen that psychologists are guided by scientific principles, and one hallmark of science is critical thinking. **Critical thinking** has many meanings. On one level, it means taking nothing for granted—not believing things just because they are in print or because they were uttered by authority figures or celebrities. On another level, critical thinking refers to a process of thoughtfully analyzing and probing the questions, statements, and arguments of others. Psychologists go one step further: they also apply critical thinking when it comes to evaluating the validity of their own research.

1-6a PRINCIPLES OF CRITICAL THINKING

1. *Be skeptical*. Keep an open mind. Politicians and advertisers try to persuade you. Are some of your attitudes and beliefs superficial or unfounded? Accept nothing as the truth until you have examined the evidence.
2. *Insist on evidence*. It is not sufficient that an opinion is traditional, that it appears in print or on the Internet, or that it is expressed by a doctor or a lawyer—or even a psychologist or a textbook author! Ask for evidence.
3. *Examine definitions of terms*. Some statements are true when a term is defined in one way, but not when it is defined in another way. Consider the statement, "Head Start programs have raised children's IQs." The correctness of the statement depends on the definition of IQ. (You will see later in the text that *IQ* is not the same thing as *intelligence*.)
4. *Examine the assumptions or premises of arguments*. Consider the statement that one cannot learn about human beings by engaging in research with animals. One premise in the statement seems to be that human beings are not animals. We are, of course.
5. *Be cautious in drawing conclusions from evidence*. For many years, studies had shown that most clients who receive psychotherapy improve. It was therefore generally assumed that psychotherapy worked. Some 60 years ago, however, psychologist Hans Eysenck pointed out that most psychologically troubled people who did *not* receive psychotherapy also improved. The question thus becomes whether people receiving psychotherapy are

critical thinking a way of evaluating the claims and comments of other people that involves skepticism and examination of evidence

more likely to improve than those who do not. Current research on the effectiveness of psychotherapy therefore compares the benefits of therapy techniques to the benefits of other techniques or no treatment at all.

6. *Be especially skeptical of anecdotes.* When you hear "I know someone who . . . ," ask yourself whether this person's reported experience is satisfactory as evidence.
7. *Consider alternative interpretations of research evidence*. Does alcohol cause aggression? We have seen that there is a connection, or *correlation*, between alcohol and aggression. But does the evidence show that drinking causes aggression? Might other factors, such as gender, age, or willingness to take risks, account for both drinking and aggressive behavior?
8. *Do not oversimplify*. Most human behavior involves complex interactions of genetic and environmental influences. For example, consider the issue of whether psychotherapy helps people with psychological problems. A broad answer to this question—a simple yes or no—might be oversimplifying. It is more worthwhile to ask: What *type* of psychotherapy, practiced by *whom*, is most helpful for *what kind of problem*?
9. *Do not overgeneralize*. Again, consider the statement that one cannot learn about humans by engaging in research with animals. Is the truth of the matter an all-or-nothing issue? Are there certain kinds of information we can obtain about people from research with animals? What kinds of things are you likely to learn only through research with people?
10. *Apply critical thinking to all areas of life*.

1-7 ETHICS IN PSYCHOLOGICAL RESEARCH

Psychologists adhere to a number of ethical standards that are intended to promote individual dignity, human welfare, and scientific integrity. The standards are also intended to ensure that psychologists do not undertake research methods or treatments that are harmful.

informed consent
a participant's agreement to participate in research after receiving information about the purposes of the study and the nature of the treatments

1-7a ETHICS OF RESEARCH WITH HUMANS

If the Lang group were running their experiment today rather than in the 1970s, they would probably have been denied permission to do so by a university ethics review committee. Why? Because the researchers gave some participants alcohol to drink—a potentially harmful treatment, especially to participants who might have drinking problems—and deceived the entire group about the purposes and methods of the study. Was their method ethical?

> "An act has no ethical quality whatever unless it be chosen out of several all equally possible."
>
> *William James*

In virtually all institutional settings, including colleges, hospitals, and research foundations, ethics review committees help researchers consider the potential harm of their methods and review proposed studies according to ethical guidelines. When such committees find that proposed research might be unacceptably harmful to participants, they may withhold approval until the proposal has been modified. Ethics review committees also weigh the potential benefits of research against the potential harm.

Today, individuals must provide **informed consent** before they participate in research (Knaus & Knaus, 2012). Having a general overview of the research and the opportunity to choose not to participate apparently give them a sense of control and decrease the stress of participating (Fisher, 2009). Is there a way in which participants in the Lang study could have provided informed consent? What do you think?

Psychologists keep the records of research participants and clients in therapy confidential because they respect people's privacy and because people are more likely to express their true thoughts and feelings when researchers or therapists keep their disclosures confidential (Fisher, 2009). Sometimes, conflicts of interest arise, as when a client threatens to harm someone, and the psychologist feels an obligation to warn the victim (Hall & Ratliff, 2017).

Some studies could not be conducted if participants know what the researchers were trying to learn or which

treatment they had received (e.g., a new drug or a sugar pill). According to the American Psychological Association's *Handbook of Ethics in Psychology* (Knaus & Knaus, 2012), psychologists may use deception only when they believe the benefits of the research outweigh its potential harm, when they believe the individuals might have been willing to participate if they had understood the benefits of the research, and when participants are **debriefed** afterward—that is, the purposes and methods of the research are explained.

Participants in the Lang study on alcohol and aggression were deceived in two ways. The researchers (1) misinformed them about what they were drinking and (2) told them they were shocking other participants when they were actually only pressing switches on an unconnected control board. (*Aggression* was defined for purposes of the study as pressing these switches.) The study could not have been run without deception, but the ethics of deceiving research participants remains debated.

1-7b ETHICS OF RESEARCH WITH ANIMALS

Psychologists and other scientists frequently use animals to conduct research that cannot be carried out with humans. For example, experiments on the effects of early separation from the mother have been done with monkeys and other animals. Such research has helped psychologists investigate the formation of parent–child bonds of attachment.

Experiments with infant monkeys highlight some of the ethical issues faced by psychologists and other scientists who contemplate potentially harmful research. Psychologists and biologists—who study the workings of the brain—destroy sections of the brains of laboratory animals to learn how they influence behavior. For instance, a lesion in one part of a brain structure causes a rat to overeat. A lesion elsewhere causes the rat to go on a crash diet. Psychologists generalize to humans from experiments such as these in the hope of finding solutions to problems such as eating disorders (Mehta & Gosling, 2008). Proponents of the use of animals in research argue that major advances in medicine and psychology could not have taken place without them (Janis et al., 2018; Ringach & Jentsch, 2009). For example, we would know much less about how experimental drugs affect cancerous growths and the brain.

BonkersAboutScience/Alamy Stock Photo

Standards for Animal Research
Researchers in many fields—including psychology, biology, and medical sciences—use animals for studies they could or would not run with human participants. In such cases, psychologists have strict standards as to how animals are to be cared for and treated.

According to the ethical guidelines of the APA (2002, 2012a), animals may be harmed only when there is no alternative and when researchers believe that the benefits of the research justify the harm.

Now that we have an overview of psychology as a science, we will move on to the connections between psychology and biology in Chapter 2. Psychologists assume that our behaviors and our mental processes are related to biological events. In Chapter 2, we consider the evidence for this assumption.

debrief to explain the purposes and methods of a completed procedure to a participant

APPLICATION

Thinking Critically About All Those Self-Help Books—Are There Any Quick Fixes?

You Are a Badass (pardon my French!); *The Secrets You Keep; Girl, Wash Your Face; Becoming Whole: A Healing Companion, to Ease Emotional Pain and Find Self-Love; Rebellious Aging: A Self-Help Guide for the Old Hippie at Heart; Not Nice: Stop People Pleasing, Staying Silent, and Feeling Guilty . . .*

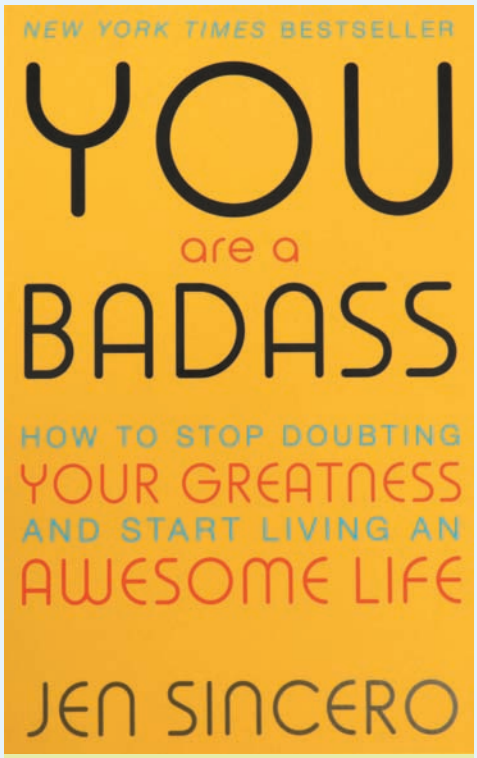
These are just a few of the self-help books that are flooding the marketplace. Every day, shy people, anxious people, heavy people, stressed people, and confused people scan bookstores, online book listings, and supermarket checkout racks in hope of finding the book that will provide the answer. How can they evaluate the merits of these books?

Unfortunately, there are no easy answers. Many of us believe the things we see in print, and anecdotes about how chubby Bubba lost 60 pounds in 60 days and how shy Shelly blossomed into a social butterfly in a month can have a powerful allure.

But be on guard. A price we pay for freedom of speech is that nearly anything can wind up in print. Authors can make extravagant claims with little fear of punishment. They can lie about the effectiveness of a new fad diet as easily as they can lie about being kidnapped by a UFO.

To help separate the meaningful wheat from the nonsensical chaff, use some critical thinking:

1. *First, don't judge the book by its cover or its title.* Good books as well as bad books can have catchy titles and interesting covers. Numerous books are competing for your attention. It is little wonder, then, that publishers try to do something sensational with the covers.
2. *Avoid books that make extravagant claims.* If it sounds too good to be true, it probably is. No method helps everyone who tries it. Very few methods work overnight. The book that promises to make you fit in 10 days will outsell the book that says it will take 10 weeks. Responsible psychologists and health professionals do not make lavish claims.
3. *Check authors' educational credentials.* Be suspicious if the author's title is just "Dr." and is placed before the name. The degree could be a phony doctorate purchased online. It could be issued by a religious cult rather than a university or professional school. It is better if the "doctor" has an MD, PhD, PsyD, or EdD after the individual's name rather than "Dr." in front of it.
4. *Check authors' affiliations.* Authors who are affiliated with colleges and universities may be more credible than those who are not.
5. *Consider authors' complaints about the conservatism of professional groups to be a warning.* Do the authors boast that they are ahead of their time? Do they berate professional health organizations as pigheaded or narrow-minded? If so, be suspicious.
6. *Check the evidence reported in the book.* Poor-quality self-help books tend to make extensive use of anecdotes—unsupported stories about the fantastic results achieved by a few individuals. When possible, they cite the reports of celebrities and authority figures. Responsible psychologists and other health professionals check the effectiveness of techniques with carefully constructed samples of people. They carefully measure the outcomes and qualify their statements about their results, as by saying "It seems that . . ."



Ben Molyneux/Alamy Stock Photo

A Best Seller!
Should you log on and order a copy right now? The author labels herself a "success coach." What does that mean? As a critical thinker, should you want to know before you follow her advice?

7. *Check the reference citations for the evidence.* Legitimate psychological research is reported in the kinds of journals you will find in the reference section of this book. If there are no reference citations, or if the list of references seems suspicious, you should be suspicious, too.
8. *Read textbooks and professional books rather than self-help books.* Search the college bookstore for texts in fields that interest you.
9. *Stop by and chat with your psychology professor.* Talk to someone in your college or university health center.

In sum, there are few, if any, quick fixes to psychological and health problems. Do your homework. Become a critical consumer of self-help books.

CHAPTER REVIEW

Total Recall! Fill in the Blanks

Answers can be found in the back of the book.

1. Psychology is defined as the study of _____ and mental processes.
2. _____ psychologists evaluate problems such as anxiety and depression through interviews and psychological tests.
3. _____ founded the school of structuralism.
4. _____ psychologists saw our perceptions as wholes that give meaning to parts.
5. _____ psychologists note that only the fittest organisms reach maturity and reproduce, thereby transmitting their genes to future generations and causing species to evolve in adaptive directions.
6. Kenneth and Mamie Phipps _____ conducted research that influenced a Supreme Court decision on segregated schools.
7. Samples must accurately represent the target _____.
8. In the _____ method, a large sample of people answer questions about their attitudes or behavior.
9. Ideal experiments use experimental groups and _____ groups.
10. Psychologists adhere to _____ standards that help promote the dignity of the individual, maintain scientific integrity, and protect research participants and clinical clients from harm.

Multiple Choice

1. **Psychology is defined as the scientific study of**
   a. behavior and mental processes.
   b. diagnosis and treatment of behavioral disorders.
   c. conscious and unconscious mental processes.
   d. the mind.

2. **School psychologists are employed by school districts to**
   a. develop achievement and aptitude tests.
   b. identify and assist students who have problems that interfere with their learning.
   c. assess the development of children in the school system.
   d. develop curriculum for teachers to deliver.

3. **What distinguished Wilhelm Wundt's contribution from other contributions to psychology?**
   a. He wrote the first textbook of psychology.
   b. He defined psychology as the science of behavior.
   c. He established psychology as a laboratory science.
   d. He studied insight in lower animals.

4. **The school of psychology that places unconscious impulses and desires at the center of human behavior is**
   a. psychoanalysis.
   b. humanism–existentialism.
   c. functionalism.
   d. Gestalt psychology.

5. **The first female president of the American Psychological Association was**
   a. Mary Ainsworth.
   b. Elizabeth Loftus.
   c. Karen Horney.
   d. Mary Whiton Calkins.

6. **A(n) _____ is a specific statement about behavior or mental processes that is tested through research.**
   a. observation
   b. scientific method
   c. theory
   d. hypothesis

7. **In a _____, each member of a population has an equal chance of being selected to participate.**
   a. random sample
   b. selection sample
   c. stratified sample
   d. free sample

8. **A disadvantage of survey research is _____. For example, people tend to overrate behaviors like church attendance and proper hygiene.**
   a. inaccurate self-report
   b. too much detail
   c. that people are too honest
   d. too few survey companies

9. **You design a test of intelligence. On the theory that intelligence is related to academic performance, you use _____ to test the relationship between performance on your new test and grades in school.**
   a. an experimental method
   b. a test–retest method
   c. the correlational method
   d. naturalistic observation

10. **Dr. Liu was interested in testing the effects of violent television on 6-year-old children. She showed one group a particularly violent episode of *Power Rangers* and another group watched a short nonviolent episode of an old *Sesame Street*. She then observed the groups in the playground and measured their behaviors. What is the dependent variable in this study?**
    a. *Sesame Street*
    b. The violent or nonviolent television show
    c. The behavior on the playground
    d. The amount of time watching television

2 Biology and Psychology

Science Photo Library/Alamy Stock Photo

LEARNING OUTCOMES

After studying this chapter, you will be able to . . .

- **2-1** Describe the nervous system, including neurons, neural impulses, and neurotransmitters.
- **2-2** Describe the functions of the peripheral and central nervous systems.
- **2-3** Describe the ways in which researchers study the functions of the brain.
- **2-4** Describe the parts and functions of the hindbrain, the midbrain, and the forebrain.
- **2-5** Describe the functions of various parts of the cerebral cortex.
- **2-6** Explain the role of the endocrine system in behavior and mental processes, and describe the functions of the various endocrine glands.
- **2-7** Define evolutionary psychology, and explain the connections between heredity, behavior, and mental processes.

In the film *Concussion*, Will Smith plays Nigerian doctor Bennet Omalu, who performed an autopsy on former Pittsburgh Steelers center Mike Webster. Webster had been sliding into strange behavior for years before his untimely death at the age of 50, not the least of which was stunning himself unconscious with a Taser gun to relieve his back pain.

The doctor found tau proteins in Webster's brain. These proteins killed cells in those areas of the brain connected with executive functioning (solving problems, making decisions), mood, and emotions. The pattern of brain devastation associated with this disease has since been found in the donated brains of an alarming number of football players. The disease is called *chronic traumatic encephalopathy (CTE)*, which gives rise to dementia (loss of memory, impaired reasoning, and other problems) and feelings of depression severe enough to lead to suicide. Among football players, the disease is caused by repeated "bell-ringing"—that is, potentially concussive—blocks and tackles.

A Mayo Clinic study found CTE in the brains of 21 out of 66 men who had participated in contact sports such as football, and completely absent in the brains of 198 men who had not participated in contact sports (Bienick et al., 2015). A more recent study found CTE in the brains of 177 out of 202 former football players (Mez et al., 2017).

The National Football League is struggling to come to grips with the fallout from these findings. The league initially resisted the idea that the repeated head banging was killing its players, but it has more recently attempted to develop more protective helmets and has instituted concussion protocols to rest or remove injured players from the field.

AF archive/Alamy Stock Photo

Will Smith in the movie *Concussion*

Football has become something of a guilty pleasure among fans who now know very well the risks it entails. Meanwhile, adjustments are also being made to reduce harmful tackling in youth leagues, and millions of parents are guiding their children into less dangerous sports.

In this chapter we learn about the parts of the brain discussed in the film *Concussion* and a great deal more. We will travel from the small to the large, from the microscopic brain cells that receive, store, and transmit information, to the visible brain structures that provide the basis for such psychological functions as memory, thought, planning, language, and sensation and movement.

TRUTH OR FICTION?

WHAT DO YOU THINK? FOLKLORE, COMMON SENSE, OR NONSENSE? SELECT T FOR "TRUTH" OR F FOR "FICTION," AND CHECK THE ACCURACY OF YOUR ANSWERS AS YOU READ THROUGH THE CHAPTER.

T	F	Cells are microscopic, yet a single cell can stretch all the way from your spine to your toe.
T	F	Messages travel in the brain by means of electricity.
T	F	A brain cell can send out hundreds of messages each second—and manage to catch some rest in between.
T	F	Fear can give you indigestion.
T	F	The human brain is larger than the brain of any other animal.
T	F	If a surgeon were to stimulate a certain part of your brain electrically, you might swear that someone had stroked your leg.
T	F	Charles Darwin was nearly excluded from the voyage that led to the development of his theory of evolution because the captain of the ship did not like the shape of his nose.

2-1 THE NERVOUS SYSTEM: ON BEING WIRED

The nervous system is a complex system of nerves that are involved in thought processes, heartbeat, visual–motor coordination, and so on. The nervous system consists of the brain, the spinal cord, and other parts that make it possible for us to receive information from the world outside and to act on it. It is composed of cells, most of which are *neurons*. Here we begin our study of the nervous system.

2-1a NEURONS: INTO THE FABULOUS FOREST

Within our nervous system lies a fabulous forest of nerve cells, or neurons. **Neurons** are specialized cells of the nervous system that conduct impulses. Neurons can be visualized as having branches, trunks, and roots—something like trees. As we voyage through this forest, we see that many nerve cells lie alongside one another as in a thicket of trees. But neurons can also lie end to end, with their "roots" intertwined with the "branches" of the neurons that lie below. Neurons receive "messages" from a number of sources such as light, other neurons, and pressure on the skin, and they can pass these messages along in a complex biological dance. We are born with more than 100 billion neurons, most of which are in the brain.

neuron a specialized cell of the nervous system that receives and transmits messages

glial cells cells that remove dead neurons and waste products from the nervous system, nourish and insulate neurons, form myelin, and play a role in neural transmission of messages

dendrites rootlike structures, attached to the cell body of a neuron, that receive impulses, or incoming messages, from other neurons

axon a long, thin part of a neuron that transmits impulses to other neurons from bulb-shaped structures called *axon terminals* or *terminal buttons*

myelin a fatty substance that encases and insulates axons, facilitating transmission of neural impulses

The nervous system also contains **glial cells**. Glial cells remove dead neurons and waste products from the nervous system; nourish and insulate neurons; form a fatty, insulating substance called *myelin*; and play a role in the neural transmission of messages (Mederos & Perea, 2019). But neurons occupy center stage in the nervous system. The messages transmitted by neurons somehow account for phenomena ranging from the perception of an itch from a mosquito bite, to the coordination of a skier's vision and muscles to the composition of a concerto and to the solution of an algebraic equation.

Neurons vary according to their functions and their location. Neurons in the brain may be only a fraction of an inch in length, whereas neurons in the legs can be several feet long. Most neurons include a cell body, dendrites, and an axon (see Figure 2.1). The cell body contains the core or *nucleus* of the cell. The nucleus uses oxygen and nutrients to generate the energy needed to carry out the work of the cell. Anywhere from a few to several hundred short fibers, or **dendrites**, extend like roots from the cell body to receive incoming messages from thousands of adjoining neurons.

Each neuron has an **axon** that extends like a trunk from the cell body. Axons are very thin, but those that carry messages from the toes to the spinal cord extend several feet in length—even though they remain microscopic! Like tree trunks, axons can branch in different directions. Axons end in small, bulb-shaped structures called *axon terminals* or *terminal buttons*. Neurons carry messages in one direction only: from the dendrites or cell body through the axon to the axon terminals. The messages are then transmitted from the terminal buttons to other neurons, muscles, or glands.

TRUTH

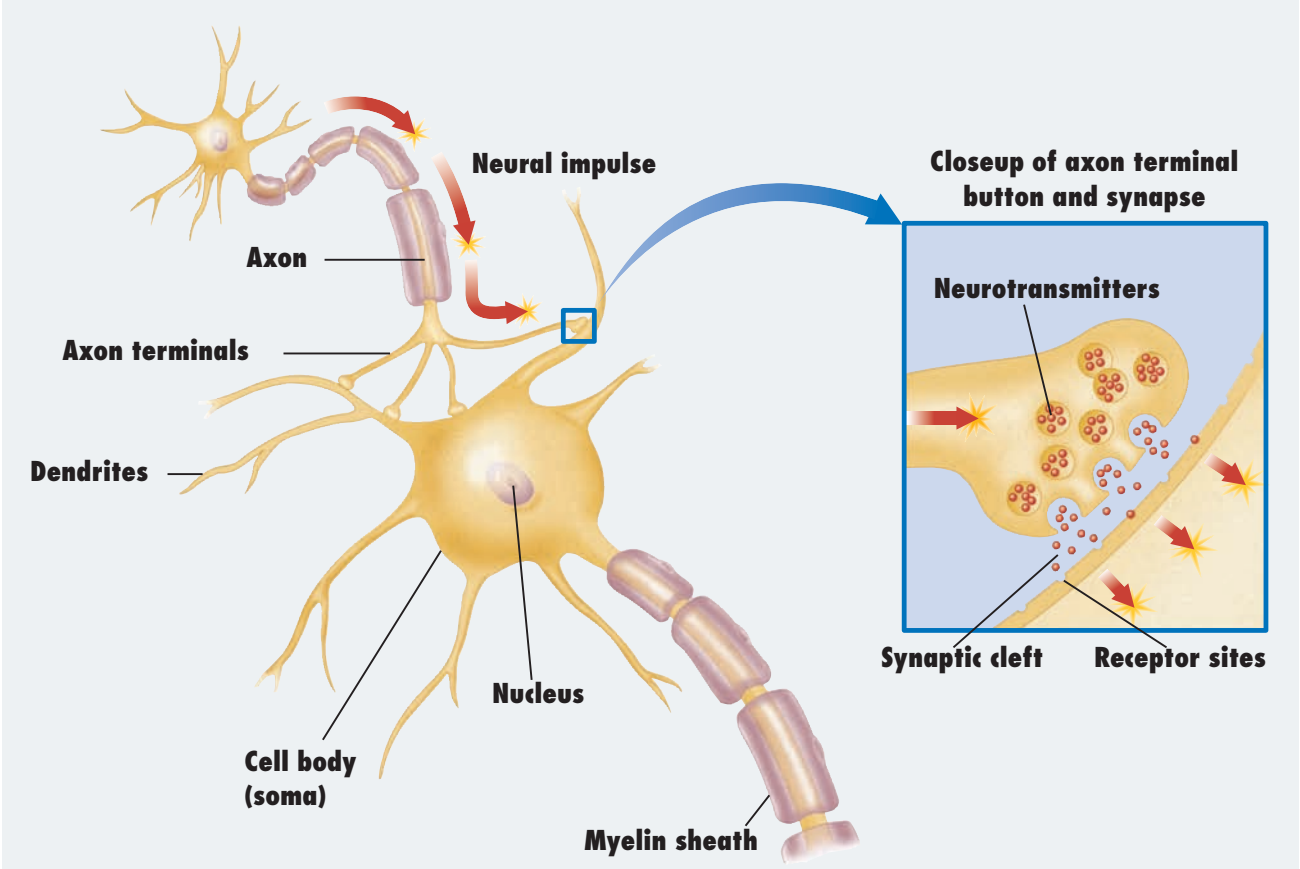
It is **true** that a single cell can stretch all the way from your spine to your toe, yet the cell will remain "microscopic" because of its thinness.

As a child matures, the axons of neurons become longer and the dendrites and terminals proliferate, creating vast interconnected networks for the transmission of complex messages. The number of glial cells also increases as the nervous system develops, contributing to its dense appearance.

MYELIN The axons of many neurons are wrapped tightly with white, fatty **myelin** that makes them look like strings of sausages under a microscope (Figure 2.1). The fat insulates the axon from electrically charged atoms, or *ions*, found in the fluids that surround the nervous system. The myelin sheath minimizes leakage of the electrical current being carried along the axon, thereby allowing messages to be conducted more efficiently.

Myelination is part of the maturation process that leads to a child's ability to crawl and walk during the first

FIG. 2.1 THE ANATOMY OF A NEURON



"Messages" enter neurons through dendrites, are transmitted along the trunklike axon, and then are sent from axon terminal buttons to muscles, glands, and other neurons. Axon terminal buttons contain sacs of chemicals called *neurotransmitters*. Neurotransmitters are released into the *synaptic cleft*, where many of them bind to *receptor sites* on the dendrites of the receiving neuron.

year. Infants are not physiologically "ready" to engage in visual–motor coordination and other activities until the coating process reaches certain levels. In people with the disease multiple sclerosis, myelin is replaced with a hard, fibrous tissue that throws off the timing of nerve impulses and disrupts muscular control.

AFFERENT AND EFFERENT NEURONS If someone steps on your toes, the sensation is registered by receptors or sensory neurons near the surface of your skin. Then it is transmitted to the spinal cord and brain through *sensory neurons*, or **afferent neurons**, which can be as long as 2–3 feet in length. In the brain, subsequent messages might be conveyed by associative neurons that are only a few thousandths of an inch long. You experience the pain through this process and perhaps entertain some rather nasty thoughts about the perpetrator, who is now apologizing and begging for understanding.

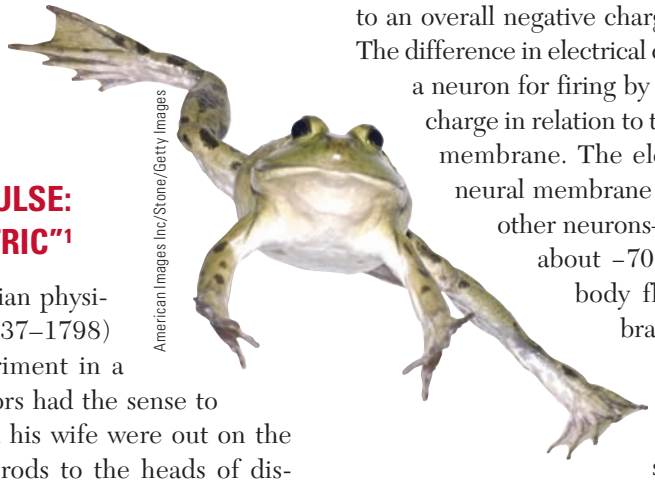
Long before you arrive at any logical conclusions, however, *motor neurons*, or **efferent neurons**, send messages to your foot so that you withdraw it and begin an impressive hopping routine. Efferent neurons transmit messages from the brain or spinal cord to muscles and glands. Other efferent neurons stimulate glands so that your heart is beating more rapidly, you are sweating, and the hair on the back of your arms has become erect! Being a good sport, you say, "Oh, it's nothing." But considering all the neurons involved, it really is something, isn't it?

In case you think that afferent and efferent neurons will be hard to distinguish because they sound pretty much the

afferent neurons neurons that transmit messages from sensory receptors to the spinal cord and brain; also called *sensory neurons*

efferent neurons neurons that transmit messages from the brain or spinal cord to muscles and glands; also called *motor neurons*

SAME to you, remember that they *are* the "SAME," that is, "Sensory is to Afferent as Motor is to Efferent."


American Images Inc/Stone/Getty Images

2-1b THE NEURAL IMPULSE: "THE BODY ELECTRIC"[1]

In the 18th century, the Italian physiologist Luigi Galvani (1737–1798) conducted a shocking experiment in a rainstorm. While his neighbors had the sense to remain indoors, Galvani and his wife were out on the porch connecting lightning rods to the heads of dissected frogs whose legs were connected by wires to a well of water. When lightning blazed above, the frogs' muscles contracted. Galvani was demonstrating that the messages—or **neural impulses**—that travel along neurons are electrochemical in nature.

Neural impulses are messages that travel within neurons at somewhere between 2 (in nonmyelinated neurons) and 225 miles an hour (in myelinated neurons). This speed is not impressive when compared with that of an electrical current in a toaster oven or a lamp, which can travel at close to the speed of light—over 186,000 miles per second. But distances in the body are short, and a message will travel from a toe to the brain in perhaps 1/50th of a second.

neural impulses the electrochemical discharge of a nerve cell or neuron

polarize to ready a neuron for firing by creating an internal negative charge in relation to the body fluid outside the cell membrane

resting potential the electrical potential across the neural membrane when it is not responding to other neurons

depolarize to reduce the resting potential of a cell membrane from about 70 millivolts toward zero

action potential the electrical impulse that provides the basis for the conduction of a neural impulse along an axon of a neuron

AN ELECTROCHEMICAL VOYAGE The process by which neural impulses travel is electrochemical. Chemical changes take place within neurons that cause an electrical charge to be transmitted along their lengths. Neurons and body fluids contain *ions*—positively or negatively charged atoms. In a resting state—that is, when a neuron is not being stimulated by its neighbors—negatively charged chloride (Cl^-) ions are plentiful within the neuron, contributing to an overall negative charge in relation to the outside. The difference in electrical charge readies, or **polarizes**, a neuron for firing by creating an internal negative charge in relation to the body fluid outside the cell membrane. The electrical potential across the neural membrane when it is not responding to other neurons—its **resting potential**—is about –70 millivolts in relation to the body fluid outside the cell membrane (see Figure 2.2).

When an area on the surface of the resting neuron is adequately stimulated by other neurons, the cell membrane in the area changes its permeability to allow positively charged sodium ions to enter. Thus, the area of entry becomes positively charged, or **depolarized**, with respect to the outside (see Figure 2.2A). The permeability of the cell membrane then changes again, allowing no more sodium ions to enter (see Figure 2.2B).

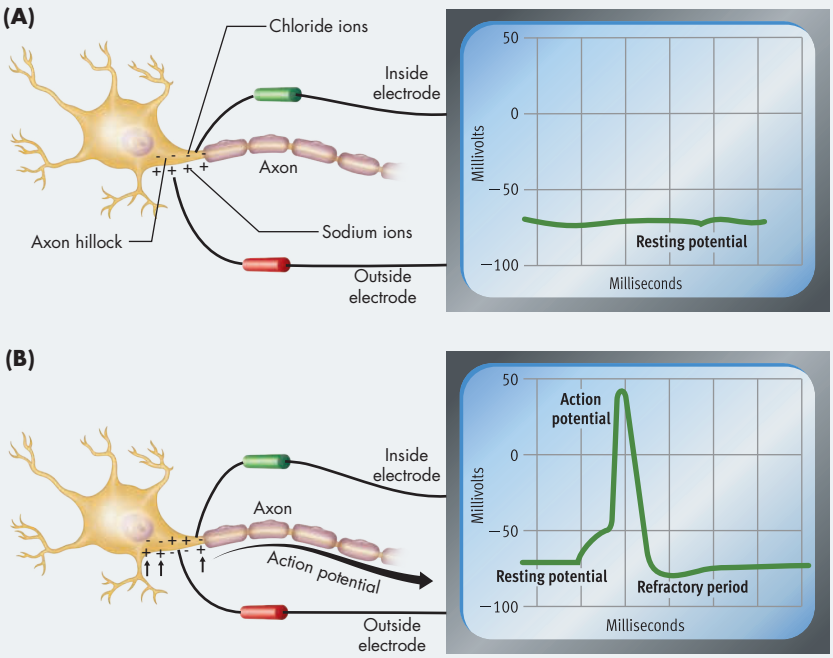
The electrical impulse that provides the basis for the conduction of a neural impulse along an axon of a neuron is termed its **action potential**. The inside of the cell axon at the disturbed area has an action potential of 110 millivolts. This action potential, added to the –70 millivolts that characterize the resting potential, brings the membrane voltage to a positive charge of about +30 to +40 millivolts (see Figure 2.2). This inner change causes the next section of the cell to become permeable to sodium ions. At the same time, other positively charged (potassium) ions are being pumped out of the area of the cell that was previously affected, which returns the area to its resting potential. In this way, the neural impulse is transmitted continuously along an axon. Because the impulse is created anew as it progresses, its strength does not change.

FIRING: HOW MESSAGES VOYAGE FROM NEURON TO NEURON The conduction of the neural impulse along the length of a neuron is what is meant by *firing*. When a rifle fires, it sends a bullet speeding through its barrel and discharges it at more than 1,000 feet per second. Neurons also fire, but instead of having a barrel, a neuron has an axon. Instead of discharging a bullet, it releases *neurotransmitters*.

Some neurons fire in less than 1/1,000th of a second. When they fire, neurons transmit messages to other neurons, muscles, or glands. However, neurons will not fire unless the incoming messages combine to reach a certain strength, which is defined as the

[1]From the Walt Whitman poem, "I Sing the Body Electric."

FIG. 2.2 CHANGES IN ELECTRICAL CHARGES AS A NEURAL IMPULSE IS TRANSMITTED ALONG THE LENGTH OF AN AXON



Electrical charges inside and outside axons are measured by microscopic glass tubes placed inside and outside the cell membranes of axons. As shown in A, when an axon is at rest, it has a negative charge of about –70 millivolts. But when sodium ions enter and the area of entry is depolarized, as shown in B, the charge in that part of the axon rises to +30 to +40 millivolts. The change causes the next part of the cell membrane to become permeable to sodium ions, continuing the transmission of the neural impulse along the axon.

threshold at which a neuron will fire. A weak message may cause a temporary shift in electrical charge at some point along the cell membrane, but this charge will dissipate if the neuron is not stimulated to its threshold.

TRUTH

It is **true** that messages *within* neurons travel by means of electricity. But as you see in Figure 2.2, chemicals (including sodium and chloride ions) are also involved in the neural impulse. Moreover, communication *between* neurons is carried out by transmitting chemicals from one neuron to the other.

Every time a neuron fires, it transmits an impulse of the same strength. This occurrence is known as the **all-or-none principle**. That is, either a neuron fires or it doesn't. Neurons fire more often when they have been stimulated by larger numbers of other neurons. Stronger stimuli cause more frequent firing, but again, the strength of each firing remains the same.

For a few thousandths of a second after firing, a neuron is in a **refractory period**; that is, it is insensitive to messages from other neurons and will not fire. This period is a time of recovery during which sodium is prevented from passing through the neuronal membrane. Because such periods of "recovery" might occur hundreds of times per second, it seems a rapid recovery and a short rest indeed.

THE SYNAPSE: ON BEING WELL CONNECTED A neuron relays its message to another neuron across a junction called a **synapse**. A synapse consists of an axon terminal from the transmitting neuron, a dendrite, or the body of a receiving neuron, and a fluid-filled gap between the two that is called the *synaptic cleft* (see Figure 2.1). Although the neural impulse is electrical, it does not jump across the synaptic cleft like a spark. Instead, when a nerve impulse reaches a synapse, axon terminals release chemicals into the synaptic cleft like myriad ships being cast into the sea. Researchers have identified a few dozen of these chemicals to date. Let's consider a few that are usually of the greatest interest to psychologists.

all-or-none principle the fact that a neuron fires an impulse of the same strength whenever its action potential is triggered

refractory period a phase following firing during which a neuron is less sensitive to messages from other neurons and will not fire

synapse a junction between the axon terminals of one neuron and the dendrites or cell body of another neuron

TRUTH

It is **true** that a brain cell—that is, a neuron in the brain—can send out hundreds of messages each second and manage to catch some rest in between. That "rest" is termed the *refractory period*.

2-1c NEUROTRANSMITTERS: THE CHEMICAL KEYS TO COMMUNICATION

Sacs called *synaptic vesicles* in the axon terminals contain **neurotransmitters**—the chemical keys to communication (see Figure 2.1). When a neural impulse (action potential) reaches the axon terminal, the vesicles release varying amounts of neurotransmitters into the synaptic cleft. From there, they influence the receiving neuron.

Each kind of neurotransmitter has a unique chemical structure, and each can fit into a specifically tailored harbor, or **receptor site**, on the receiving cell (see Figure 2.1). The analogy of a key fitting into a lock is often used to describe this process. Once released, not all molecules of a neurotransmitter find their way into receptor sites of other neurons. "Loose" neurotransmitters are usually either broken down or reabsorbed by the axon terminal (a process called *reuptake*).

Some neurotransmitters act to *excite* other neurons—that is, to cause other neurons to fire. Other neurotransmitters *inhibit* receiving neurons. That is, they prevent the neurons from firing. The sum of the stimulation—excitatory and inhibitory—determines whether a neuron will fire.

Neurotransmitters are involved in physical processes (e.g., muscle contraction) and psychological processes (e.g., thoughts and emotions). Excesses or deficiencies of neurotransmitters have been linked to psychological disorders such as depression and schizophrenia. Let's consider the effects of some neurotransmitters that are of interest to psychologists: acetylcholine (ACh), dopamine, norepinephrine, serotonin, gamma-aminobutyric acid, and endorphins.

neurotransmitters chemical substances involved in the transmission of neural impulses from one neuron to another

receptor site a location on a dendrite of a receiving neuron tailored to receive a neurotransmitter

acetylcholine (ACh) a neurotransmitter that controls muscle contractions

hippocampus a structure of the brain that is involved in memory formation

dopamine a neurotransmitter that affects the ability to perceive pleasure, voluntary movement, and learning and memory; it is involved in Parkinson's disease and appears to play a role in schizophrenia

Acetylcholine (ACh) is a neurotransmitter that controls muscle contractions. It is excitatory at synapses between nerves and muscles that involve voluntary movement but inhibitory at the heart and some other locations. The effects of the poison *curare* highlight the functioning of ACh. Curare is extracted from plants by South American indigenous people and used in hunting. If an arrow tipped with curare pierces the skin and the poison enters the body, it prevents ACh from binding to the receptor sites on neurons. Because ACh helps muscles move, curare causes paralysis. The victim is prevented from contracting the muscles used in breathing and dies from suffocation. Botulism, a disease that stems from food poisoning, prevents the release of ACh and has the same effect as curare.

ACh is normally prevalent in a part of the brain called the **hippocampus**, a structure involved in the formation of memories (Ekstrom & Ranganath, 2017). When the amount of ACh available to the brain decreases, as in Alzheimer's disease, memory formation is impaired (Karthick et al., 2019). In one experiment, researchers decreased the ACh available to the hippocampus of laboratory rats. As a result, the rats were incapable of learning their way through a maze, apparently because they could not remember which way to turn at various choice points (Egawa et al., 2002).

Dopamine is a neurotransmitter that acts in the brain and affects the ability to perceive pleasure, voluntary movement, and learning and memory. Nicotine, alcohol, and many other drugs are pleasurable because they heighten levels of dopamine. Deficiencies of dopamine are linked to Parkinson's disease, in which people progressively lose control over their muscles (McGuigan et al., 2019). They develop muscle tremors and jerky, uncoordinated movements.

The psychological disorder *schizophrenia* is characterized by confusion and false perceptions, and it has been linked to dopamine. People with schizophrenia may have more receptor sites for dopamine in an area of the brain that is involved in emotional responding. For this reason, they may "overutilize" the dopamine available in the brain (Hernaus et al., 2019). Overutilization is connected with hallucinations and disturbances of thought and emotion. The phenothiazines, a group of drugs used in the treatment of schizophrenia, inhibit the action of dopamine by blocking some dopamine receptors (Uno & Coyle, 2019). Because of their action, phenothiazines may have Parkinson's-like side effects, which are usually lessened by lowering the dosage or prescribing other drugs.

STEPHEN JAFFE/AFP/Getty Images

Boxer Muhammad Ali (1942–2016) and actor Michael J. Fox are two of the better-known individuals afflicted with Parkinson's disease. Parkinson's disease is linked to deficiencies of the neurotransmitter dopamine. Dopamine is also involved in the experiencing of pleasure.

Norepinephrine is produced largely by neurons in the brain stem and acts both as a neurotransmitter and as a hormone. It is an excitatory neurotransmitter that speeds up the heartbeat and other body processes and is involved in general arousal, learning and memory, and eating. Excesses and deficiencies of norepinephrine have been linked to mood disorders. Deficiencies of both ACh and norepinephrine particularly impair memory formation (Gold, 2015).

The stimulants cocaine and amphetamine ("speed") boost norepinephrine (as well as dopamine) production, increasing the firing of neurons and leading to persistent arousal. Amphetamines both facilitate the release of these neurotransmitters and prevent their reuptake. Cocaine also blocks reuptake.

Serotonin is a neurotransmitter that is involved in emotional arousal and sleep. Deficiencies of serotonin have been linked to eating disorders, alcoholism, depression, aggression, and insomnia (Leslie, 2019; Pires et al., 2016). The drug LSD decreases the action of serotonin and is also believed to increase the utilization of dopamine, which may be the mechanism by which it produces hallucinations.

Gamma-aminobutyric acid (GABA) is another neurotransmitter of great interest to psychologists. One reason is that GABA is an inhibitory neurotransmitter that may help calm anxiety reactions (Liu et al., 2019). Tranquilizers and alcohol may quell anxiety by binding with GABA receptors and amplifying its effects. One class of antianxiety drug may also increase the sensitivity of receptor sites to GABA. Other studies link deficiencies of GABA to depression (Romeo et al., 2018).

Endorphins are inhibitory neurotransmitters. The word *endorphin* is the contraction of *endogenous morphine*. *Endogenous* means "developing from within." Endorphins occur naturally in the brain and in the bloodstream and are similar to the narcotic morphine in their functions and effects. They lock into receptor sites for chemicals that transmit pain messages to the brain. Once the endorphin "key" is in the "lock," the pain-causing chemicals are locked out. Endorphins may also increase our sense of competence, enhance the functioning of the immune system, and be connected with the pleasurable "runner's high" reported by many long-distance runners (Hicks et al., 2019).

There you have it—a fabulous forest of neurons in which billions upon billions of axon terminals are pouring armadas of neurotransmitters into synaptic clefts at any given time. The combined activity of all these neurotransmitters

> You experience your sensations, your thoughts, and your control over your body as psychological events, but the psychological events reflect billions upon billions of electrochemical events.

norepinephrine a neurotransmitter whose action is similar to that of the hormone epinephrine and that may play a role in depression

serotonin a neurotransmitter involved in emotional arousal and sleep; deficiencies of serotonin have been linked to eating disorders, alcoholism, depression, aggression, and insomnia

gamma-aminobutyric acid (GABA) an inhibitory neurotransmitter that apparently helps calm anxiety

endorphins inhibitory neurotransmitters that occur naturally in the brain and in the bloodstream and are similar to the narcotic morphine in their functions and effects

determines which messages will be transmitted and which ones will not. You experience your sensations, your thoughts, and your control over your body as psychological events, but the psychological events reflect billions upon billions of electrochemical events.

We can think of neurons as the microscopic building blocks of the nervous system. Millions upon millions of these neurons gather together to form larger, visible structures that we think of as the parts of the nervous system.

2-2 THE DIVISIONS OF THE NERVOUS SYSTEM

nerves a bundle of axons from many neurons

central nervous system (CNS) the brain and spinal cord

peripheral nervous system the part of the nervous system consisting of the somatic nervous system and the autonomic nervous system

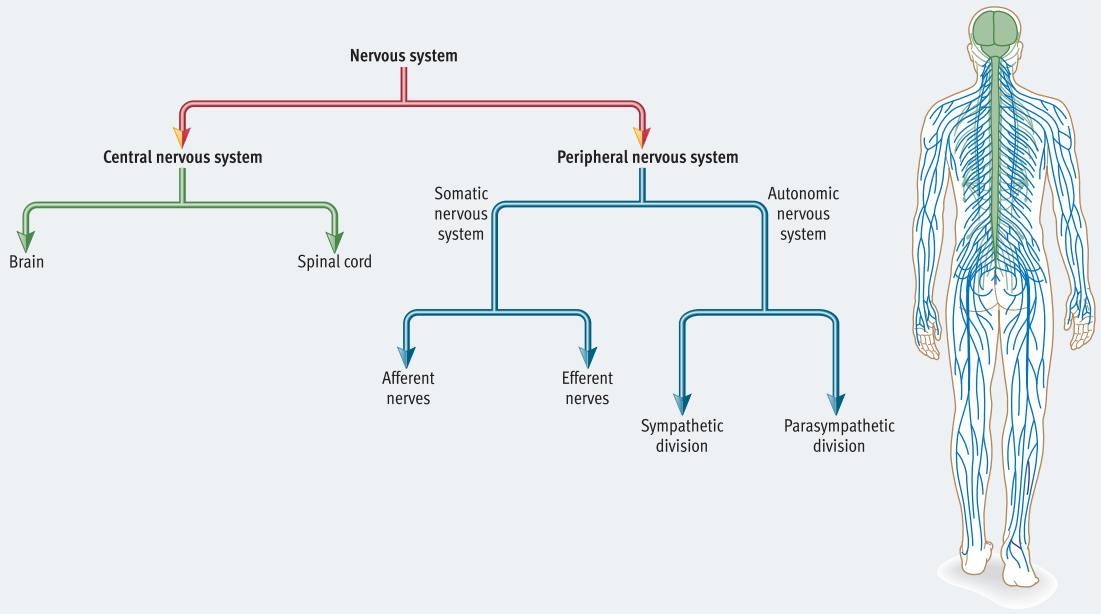
The nervous system consists of the brain, the spinal cord, and the **nerves** linking them to the sensory organs, muscles, and glands. As shown in Figure 2.3, the brain and the spinal cord make up the **central nervous system (CNS)**. If you compare your nervous system to a computer, your central nervous system would be your central processing unit.

The sensory (afferent) neurons, which receive and transmit messages to the brain and spinal cord, and the motor (efferent) neurons, which transmit messages from the brain or spinal cord to the muscles and glands, make up the **peripheral nervous system**.

2-2a THE PERIPHERAL NERVOUS SYSTEM: THE BODY'S PERIPHERAL DEVICES

The peripheral nervous system consists of sensory and motor neurons that transmit messages to and from the CNS. Without the peripheral nervous system, our brains would be like computers without keyboards, mouses, the Internet, or other ways of inputting information. There would also be no monitors, printers, modems, or other ways of displaying or transmitting information. We would be isolated from the world. We would not be able to perceive it; we would not be able to act on it. The two main divisions of the peripheral nervous system are the *somatic nervous system* and the *autonomic nervous system*.

FIG. 2.3 DIVISIONS OF THE NERVOUS SYSTEM



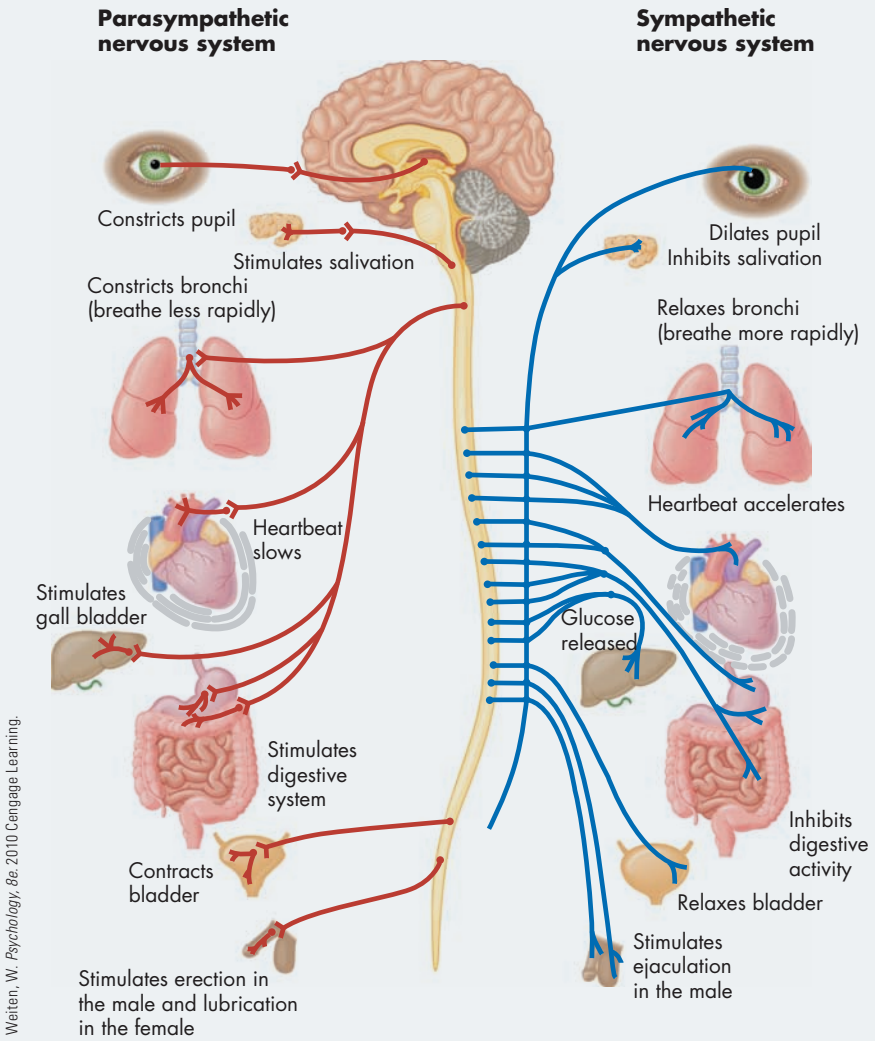
The nervous system contains two main divisions: the central nervous system and the peripheral nervous system. The central nervous system consists of the brain and spinal cord. The peripheral nervous system contains the somatic and autonomic systems. In turn, the autonomic nervous system has sympathetic and parasympathetic divisions and the somatic nervous system has afferent and efferent nerves.

The **somatic nervous system** contains sensory (afferent) and motor (efferent) neurons. It transmits messages about sights, sounds, smells, temperature, body positions, and so on, to the CNS. Messages transmitted from the brain and spinal cord to the somatic nervous system control purposeful body movements such as raising a hand, winking, or running, as well as the tiny, almost imperceptible movements that maintain our balance and posture.

The **autonomic nervous system (ANS)** also has afferent and efferent neurons and regulates the glands and the muscles of internal organs. Thus, the ANS controls activities such as heartbeat, respiration, digestion, and dilation of the pupils. These activities can occur automatically, while we are asleep. But some of them can be overridden by conscious control. You can breathe at a purposeful pace, for example. Methods like biofeedback and yoga also help people gain voluntary control of functions such as heart rate and blood pressure.

The ANS also has two branches, or divisions: *sympathetic* and *parasympathetic*. These branches have largely opposing effects. Many organs and glands are stimulated by both branches of the ANS (see Figure 2.4). When organs and glands are simultaneously stimulated by both divisions, their effects can average out to some degree. In general, the **sympathetic division** is most active during processes that involve spending body energy from stored reserves, such as a fight-or-flight response to a predator or when you find out that your rent is going to be raised. The **parasympathetic division** is most active during processes that replenish reserves of energy, such as eating. When we are afraid, the sympathetic division of the ANS accelerates the heart rate. When we relax, the parasympathetic division decelerates the heart rate. The parasympathetic division stimulates digestive

FIG. 2.4 THE BRANCHES OF THE AUTONOMIC NERVOUS SYSTEM



Weiten, W. *Psychology, 8e.* 2010 Cengage Learning.

The parasympathetic branch of the ANS generally acts to replenish stores of energy in the body. The sympathetic branch is most active during activities that expend energy. The two branches of the ANS frequently have antagonistic effects on the organs they service.

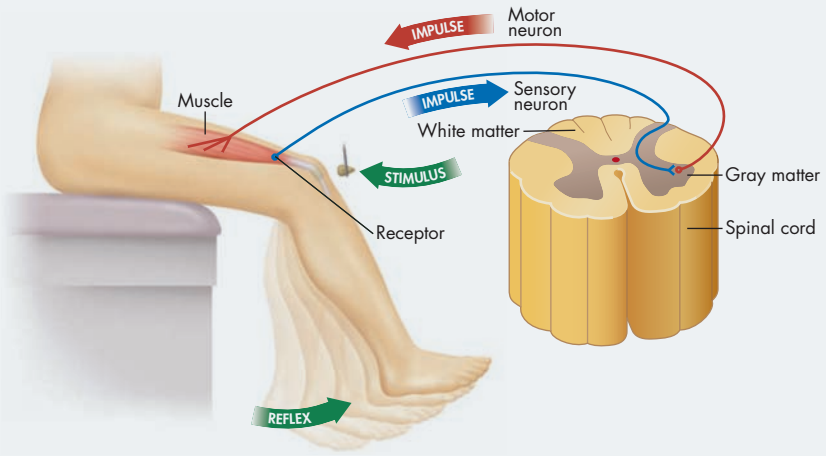
somatic nervous system the division of the peripheral nervous system that connects the central nervous system with sensory receptors, skeletal muscles, and the surface of the body

autonomic nervous system (ANS) the division of the peripheral nervous system that regulates glands and activities such as heartbeat, respiration, digestion, and dilation of the pupils

sympathetic division the branch of the ANS that is most active during emotional responses, such as fear and anxiety, that spend the body's reserves of energy

parasympathetic division the branch of the ANS that is most active during processes (such as digestion) that restore the body's reserves of energy

FIG. 2.5 THE REFLEX ARC



Reflexes are inborn, stereotyped behavior patterns that have apparently evolved because they help individuals adapt to the environment even before they can understand and purposefully manipulate the environment. Here we see a cross-section of the spinal cord, highlighting a sensory neuron and a motor neuron, which are involved in the knee-jerk reflex. In some reflexes, interneurons link sensory and motor neurons.

processes, but the sympathetic branch, which can be activated by fear, inhibits digestion. Thus, fear can give you indigestion. The ANS is of particular interest to psychologists because its activities are linked to various emotions such as anxiety and love.

2-2b THE CENTRAL NERVOUS SYSTEM: THE BODY'S CENTRAL PROCESSING UNIT

The CNS consists of the spinal cord and the brain. The **spinal cord** is a true "information superhighway"—a column of nerves as thick as a thumb. It transmits messages from sensory receptors to the brain and from the brain to muscles and glands throughout the body. The spinal cord also carries out some "local government." That is, it responds to some sources of external stimulation through spinal reflexes. A **spinal reflex** is an unlearned response to a stimulus that may require only two neurons—a sensory neuron and a motor neuron (see Figure 2.5).

spinal cord a column of nerves within the spine that transmits messages from sensory receptors to the brain and from the brain to muscles and glands throughout the body

spinal reflex a simple, unlearned response to a stimulus that may involve only two neurons

gray matter the grayish neurons and neural segments that are involved in spinal reflexes

white matter axon bundles that carry messages to and from the brain

TRUTH

It is **true** that fear can give you indigestion. Digestion is associated with *parasympathetic* nervous system activity, and fear is associated with opposing *sympathetic* activity.

In some reflexes, a third neuron, called an *interneuron*, transmits the neural impulse from the sensory neuron through the spinal cord to the motor neuron.

The spinal cord and brain contain gray matter and white matter. **Gray matter** consists of nonmyelinated neurons. Some of these are involved in spinal reflexes. Others send their axons to the brain. **White matter** is composed of bundles of longer, myelinated (and thus whitish) axons that carry messages to and from the brain. A cross-section of the spinal cord shows that the gray matter, which includes cell bodies, is distributed in a butterfly pattern (see Figure 2.5).

The spinal cord is also involved in reflexes. We blink in response to a puff of air in our faces. We swallow when food accumulates in the mouth. A physician may tap below the knee to elicit the knee-jerk reflex, a sign that the nervous system is operating adequately. Sexual response involves many reflexes. Urinating and

defecating are reflexes that occur in response to pressure in the bladder and the rectum.

It is your CNS that makes you so special. Other species see more sharply, smell more keenly, and hear more acutely. Other species run faster, or fly through the air, or swim underwater, without the benefit of artificial devices such as airplanes and submarines. But it is your CNS that enables you to use symbols and language, the abilities that allow people not only to adapt to their environment but also to create new environments and give them names.

> It is your central nervous system that makes you so special.

2-3 THE BRAIN: WIDER THAN THE SKY

When I was a child, I was told that the human nervous system is more complex than that of any other animal and that our brains are larger than those of any other animal. Now, this last piece of business is not true. A human brain weighs about 3 pounds, but the brains of elephants and whales may be four times as heavy. Still, our brains account for a greater part of our body weight than do those of elephants or whales. Our brains weigh about 1/60th of our body weight. Elephant brains weigh about 1/1,000th of their total weight, and whale brains are a paltry 1/10,000th of their weight.

FICTION

It is **not true** that the human brain is larger than the brain of any other animal. However, our brains account for a larger percentage of our body weight than do the brains of larger animals such as elephants or whales.

2-3a UNDERSTANDING THE BRAIN

Philosophers and scientists have wondered about the functions of the brain throughout history. Scientists today generally agree that the mind is a function of the brain (Gazzaniga, 2018; Grossberg, 2019). Some engage in research that attempts to pinpoint exactly what happens in certain parts of the brain when we are listening to music or trying to remember someone's face. At other times—as in the case of injured athletes—knowledge has almost fallen into their laps. From injuries to the head—some of them minimal, some horrendous—we have learned that brain damage can impair consciousness, perception, memory, and abilities to make plans and decisions. In some cases, the loss of large portions of the brain may result in little loss of function. But the loss of smaller portions in certain locations can cause language problems, memory loss, or death. It has been known for about two centuries that damage to the left side of the brain is connected with loss of sensation or movement on the right side of the body, and vice versa. Thus, it has been assumed that the brain's control mechanisms cross over from right to left, and vice versa, as they descend into the body.

Accidents provide unplanned—and uncontrolled—opportunities of studying the brain. Still, scientists learn more about the brain through methods such as experimentation, electroencephalography, and brain scans.

> "The Brain—is wider than the Sky—
> For—put them side by side—
> The one the other will contain
> With ease—and You—beside—"
>
> *Emily Dickinson (1830–1886), American poet*

2-3b EXPERIMENTING WITH THE BRAIN

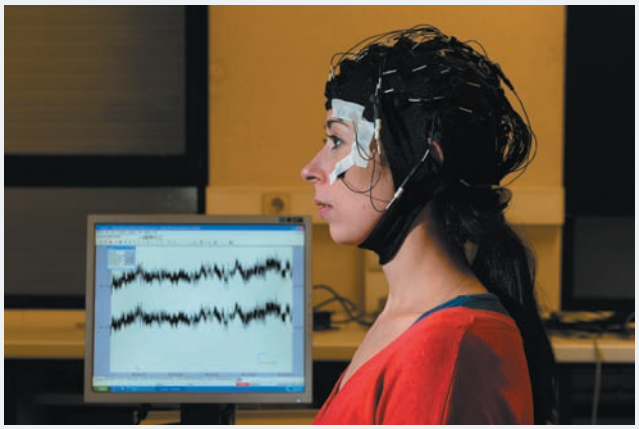
The results of disease and injuries (as in the case of football players with concussions) have shown us that brain injuries can be connected with changes in behavior and mental processes. Scientists have also purposefully damaged part of the brain in laboratory animals to observe the results. For example, damaging one part of the brain region called the *hypothalamus* causes rats to overeat. Damaging another part of the hypothalamus causes them to stop eating. It is as if parts of the brain contain on–off switches for certain kinds of behavior, at least in lower animals.

Because the brain has no receptors for pain, surgeon Wilder Penfield (1969) was able to painlessly stimulate parts of human brains with electrical probes. As a result, his patients reported perceiving certain memories.

Electrical stimulation of the brain has also shown that parts of the brain are connected with specific kinds of sensations (such as of light or sound) or motor activities (such as movement of an arm or a leg).

THE ELECTROENCEPHALOGRAPH Penfield stimulated parts of the brain with an electrical current and asked people to report what they experienced. Researchers have also used the **electroencephalograph (EEG)** to record the natural electrical activity of the brain. The EEG (see Figure 2.6) detects minute amounts of electrical activity—called *brain waves*—that pass between the electrodes. Certain brain waves are associated with feelings of relaxation, with various stages of sleep, and with neurological problems such as epilepsy.

FIG. 2.6 THE ELECTROENCEPHALOGRAPH



Sergio Azenha/Alamy Stock Photo

The EEG detects brain waves that pass between electrodes that are attached to the scalp. It has been used to reveal electrical activity associated with relaxation and the stages of sleep.

BRAIN-IMAGING TECHNIQUES In the latter years of the 20th century, researchers developed imaging techniques that use the computer's ability to generate images of the parts of the brain from sources of radiation.

Computerized axial tomography (CAT or CT), shown in Figure 2.7A, passes X-rays through the head and measures the structures that reflect the beams from various angles, generating a three-dimensional image. The CAT scan reveals deformities in shape and structure that are connected with blood clots, tumors, and other health problems.

A second method, **positron emission tomography (PET)**, shown in Figure 2.7B, forms a computer-generated image of the activity of parts of the brain by tracing the amount of glucose used (or metabolized) by these parts. More glucose is metabolized in more active parts of the brain. To trace the metabolism of glucose, a harmless amount of a radioactive compound, called a *tracer*, is mixed with glucose and injected into the bloodstream. When the glucose reaches the brain, the patterns of activity are revealed by measurement of the positrons—positively charged particles—that are emitted by the tracer.

A third imaging technique is **magnetic resonance imaging (MRI)**, which is shown in Figure 2.7C. In MRI, the person lies in a powerful magnetic field and is exposed to radio waves that cause parts of the brain to emit signals, which are measured from multiple angles. MRI relies on subtle shifts in blood flow. (More blood flows to more active parts of the brain, supplying them with oxygen.) **Functional MRI (fMRI)** provides a more rapid picture and therefore enables researchers to observe the brain in real time by taking repeated scans while subjects engage in activities such as mental processes and voluntary movements. fMRI can be used to show which parts of the brain are active when we are, say, listening to music, using language, or playing chess (Bilalić et al., 2015).

Imaging shows that the prefrontal cortex may be considered the "executive center" of the brain, where you decide to keep information in your working memory, make plans, and solve problems (Nyberg, 2018). The prefrontal cortex is the part of the frontal lobe that is closest to the front of the brain.

electroencephalograph (EEG) a method of detecting brain waves by means of measuring the current between electrodes placed on the scalp

computerized axial tomography (CAT or CT) a method of brain imaging that passes a narrow X-ray beam through the head and measures the structures that reflect the beams from various angles, enabling a computer to generate a three-dimensional image

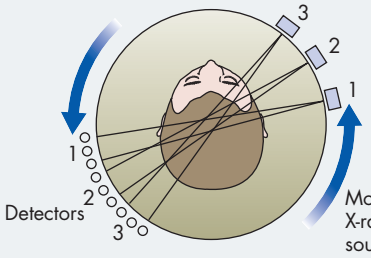
positron emission tomography (PET) a method of brain imaging that injects a radioactive tracer into the bloodstream and assesses activity of parts of the brain according to the amount of glucose they metabolize

magnetic resonance imaging (MRI) an imaging method that places a person in a magnetic field and uses radio waves to cause the brain to emit signals that reveal shifts in the flow of blood, which, when the brain is being scanned, indicate brain activity

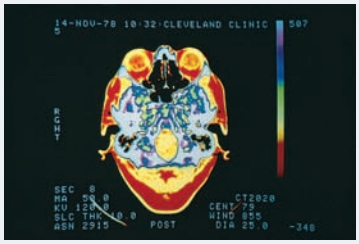
functional MRI (fMRI) a form of MRI that enables researchers to observe the brain in real time by taking repeated scans

FIG. 2.7 BRAIN-IMAGING TECHNIQUES

A. Computerized axial tomography passes a narrow X-ray beam through the head and measures structures that reflect the rays from various angles, enabling a computer to generate a three-dimensional image.

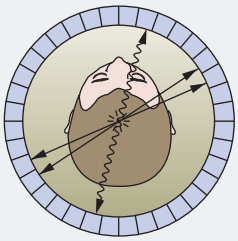


A. CAT scan

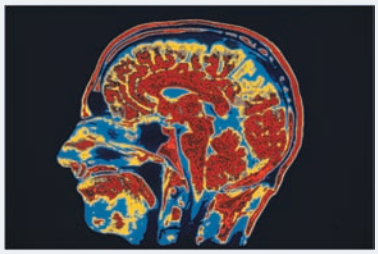


Ohio Nuclear Corporation/ Science Source

B. Positron emission tomography injects a radioactive tracer into the bloodstream and assesses activity of parts of the brain according to the amount of glucose they metabolize.

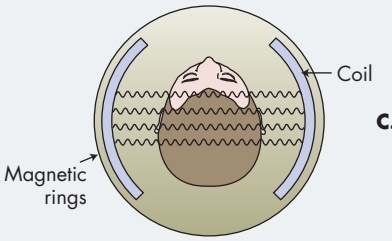


B. PET scan

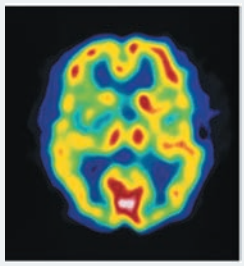


Jupiter Images

C. Magnetic resonance imaging places a person in a magnetic field and uses radio waves to cause the brain to emit signals that reveal shifts in the flow of blood that, in turn, indicate brain activity.



C. MRI



Department of Nuclear Medicine, Charing Cross Hospital/Science Source

2-4 A VOYAGE THROUGH THE BRAIN

Let's begin our tour of the brain with the *hindbrain*, where the spinal cord rises to meet the brain (see Figure 2.8). Here we find three major structures: the *medulla*, the *pons*, and the *cerebellum*. Many pathways pass through the **medulla** to connect the spinal cord to higher levels of the brain. The medulla regulates basic functions such as heart rate, blood pressure, and respiration. The medulla also plays roles in sleeping, sneezing, and coughing. The **pons** is a bulge in the hindbrain that lies forward of the medulla. *Pons* is the Latin word for "bridge"; the pons is so named because of the bundles of nerves that pass through it. The pons transmits information about body movement and is involved in functions related to attention, sleep and arousal, and respiration.

Behind the pons lies the **cerebellum** ("little brain" in Latin). The cerebellum has two hemispheres that are involved in maintaining balance and in controlling motor (muscle) behavior. You may send a command from your forebrain to get up and walk to the refrigerator, but your cerebellum is key to organizing the information that enables you to engage in these movements. The cerebellum allows you to place one leg in front of the other and reach your destination without tipping over. Injury to the cerebellum may impair motor coordination and cause stumbling and loss of muscle tone.

As we tour the hindbrain, we also find the lower part of the **reticular formation**. That is where the reticular formation begins, but it ascends through the midbrain into the lower part of the forebrain. The reticular formation is vital in the functions of attention, sleep, and arousal. Injury to the reticular formation may result in

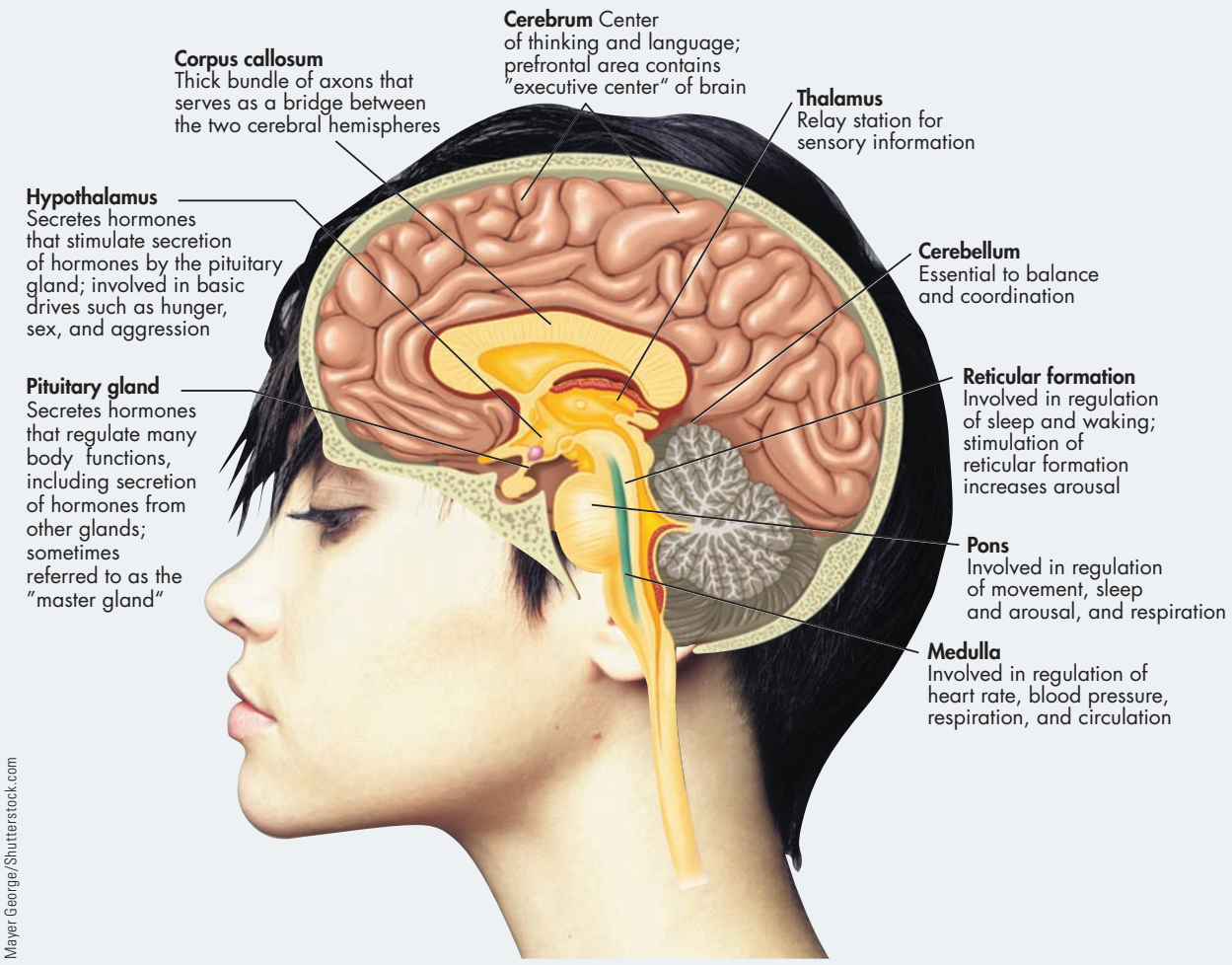
medulla an oblong area of the hindbrain involved in regulation of heartbeat, blood pressure, movement, and respiration

pons a structure of the hindbrain involved in respiration, attention, and sleep and arousal

cerebellum a part of the hindbrain involved in muscle coordination and balance

reticular formation a part of the brain involved in attention, sleep, and arousal

FIG. 2.8 THE PARTS OF THE BRAIN



The view of the brain, split top to bottom. Note how close the hypothalamus is to the pituitary gland, which allows the hypothalamus to readily influence the pituitary gland. The "valleys" in the cerebrum are called *fissures*.

a coma. Stimulation of the reticular formation causes it to send messages to the cerebral cortex (the large wrinkled mass that you think of as your brain), making us more alert to sensory information. In classic neurological research, Giuseppe Moruzzi and Horace Magoun (1949) discovered that electrical stimulation of the reticular formation of a sleeping cat caused it to awaken at once. But when the reticular formation was severed from higher parts of the brain, the cat fell into a coma from which it would not awaken. So-called "CNS depressants," such as alcohol, are thought to work, in part, by lowering the activity of the reticular formation.

thalamus an area near the center of the brain involved in the relay of sensory information to the cortex and in the functions of sleep and attention

hypothalamus a bundle of nuclei below the thalamus involved in body temperature, motivation, and emotion

Key areas of the forwardmost part of the brain, or forebrain, are the *thalamus*, the *hypothalamus*, the *limbic system*, and the *cerebrum*. The **thalamus** is located near the center of the brain and could be said to lie between the forebrain and the midbrain. It consists of two joined egg-shaped structures. The thalamus serves as a relay station for sensory stimulation. Nerve fibers from sensory systems enter from below; their information is then transmitted to the cerebral cortex by fibers that exit from above. For example, the thalamus relays sensory input from the eyes to the visual areas of the cerebral cortex. The thalamus also regulates sleep and attention in coordination with other brain structures, including the reticular formation.

The **hypothalamus** lies beneath the thalamus and above the pituitary gland. It weighs only 4 grams, yet it

is vital in the regulation of body temperature, concentration of fluids, storage of nutrients, and motivation and emotion. Experimenters learn many of the functions of the hypothalamus by implanting electrodes in parts of it and observing the effects of electrical stimulation. They have found that the hypothalamus is involved in hunger, thirst, sexual behavior, caring for offspring, and aggression. Among lower animals, stimulation of various areas of the hypothalamus can trigger instinctual behaviors such as fighting, mating, or nest building.

Psychologists James Olds and Peter Milner (1954) made a splendid mistake in the 1950s. They were attempting to implant an electrode in a rat's reticular formation to see how stimulation of the area might affect learning. Olds, however, was primarily a social psychologist and not a biological psychologist. He missed his target and found a part of the animal's hypothalamus instead. Olds and Milner dubbed this area the "pleasure center" because the animal would repeat whatever it was doing when it was stimulated. The term *pleasure center* is not used frequently because it appears to attribute human emotions to rats. Yet the "pleasure centers" must be doing something right, because rats stimulate themselves in these centers by pressing a pedal several thousand times an hour, until they are exhausted (Olds, 1969).

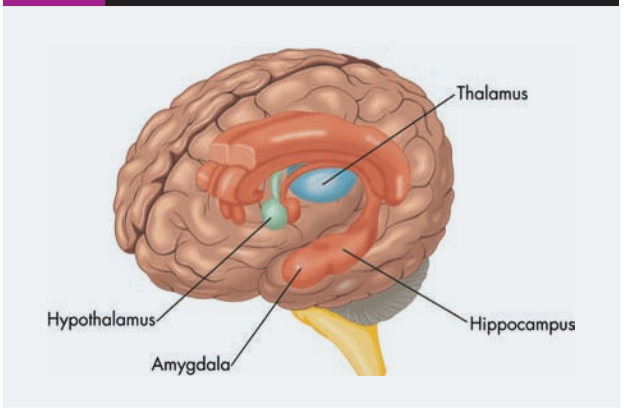
The hypothalamus is important to humans as well as to lower animals. Unfortunately (or fortunately), our "pleasure centers" are not as clearly defined as those of the rat. Then, too, our responses to messages from the hypothalamus are less automatic and relatively more influenced by higher brain functions—that is, cognitive factors such as thought, choice, and value systems.

The **limbic system** forms a fringe along the inner edge of the cerebrum and is fully evolved only in mammals (see Figure 2.9). It is made up of several structures, including the amygdala, hippocampus, and parts of the hypothalamus. It is involved in memory and emotion and in the drives of hunger, sex, and aggression. People with hippocampal damage can retrieve old memories but cannot permanently store new information. As a result, they may reread the same newspaper day in and day out without recalling that they read it before. Or they may have to be perpetually reintroduced to people they have met just hours earlier (Squire et al., 2015; Wixted et al., 2018). In Chapter 6 we will meet H. M., a man who suffered hippocampal damage and could not form new memories.

The **amygdala** is near the bottom of the limbic system and looks like two little almonds. Studies using lesioning and electrical stimulation show that the amygdala is connected with aggressive behavior in monkeys, cats, and other animals. Early in the 20th century, Heinrich Klüver and Paul Bucy (1939) lesioned part of the amygdala of a rhesus monkey. Rhesus monkeys are normally a scrappy lot and try to bite or grab at intruders, but destruction of this animal's amygdala made it docile. No longer did it react aggressively to people. It even allowed people to poke and pinch it. Electrical stimulation of the part of the amygdala that Klüver and Bucy had destroyed, however, triggers a "rage response." For example, it causes a cat to hiss and arch its back in preparation to attack. The amygdala is also connected with a fear response (Ironside et al., 2019; Thomas et al., 2019). If you electrically stimulate another part of the amygdala, the cat cringes in fear when you cage it with a mouse.

The amygdala is also connected with vigilance.

FIG. 2.9 THE LIMBIC SYSTEM



The limbic system is made up of structures that include the amygdala, the hippocampus, and parts of the hypothalamus. It is evolved fully only in mammals and forms a fringe along the inner edge of the cerebrum. The limbic system is involved in memory and emotion and in the drives of hunger, sex, and aggression.

> **"The brain is a wonderful organ; it starts working the moment you get up in the morning and does not stop until you get into the office."**
>
> *Robert Frost (1874–1963), American poet*

limbic system a group of structures involved in memory, motivation, and emotion that forms a fringe along the inner edge of the cerebrum

amygdala a part of the limbic system that apparently facilitates stereotypical aggressive responses

It is involved in emotions, learning, and memory, and it behaves something like a spotlight, focusing attention on matters that are novel and important to know more about.

Only in humans does the **cerebrum** make up such a large part of the brain (refer back to Figure 2.8). The cerebrum is responsible for thinking and language. The surface of the cerebrum—the **cerebral cortex**—is wrinkled, or convoluted, with ridges and valleys. The convolutions allow a great deal of surface area to be packed into the brain—and surface area is apparently connected with cognitive ability. Valleys in the cortex are called *fissures*. A key fissure almost divides the cerebrum in half, creating two hemispheres with something of the shape of a walnut. The hemispheres are connected by the **corpus callosum** (Latin for "hard body"), a bundle of some 200 million nerve fibers (refer back to Figure 2.8).

2-5 THE CEREBRAL CORTEX

The cerebral cortex is the part of the brain that you usually think of as your brain. *Cortex* is a Latin word meaning "bark," as in the bark of a tree. Just as the bark is the outer coating of a tree, the cerebral cortex is the outer coating of the cerebrum. Despite its extreme importance and its creation of a world of civilization and culture, it is only about 1/8th of an inch thick.

The cerebral cortex is involved in almost every bodily activity, including most sensations and responses. It is also the part of the brain that frees people from the tyranny of genetic dictates and instinct. It is the seat of thinking and language, and it enables humans to think deeply about the world outside and to make decisions.

cerebrum the large mass of the forebrain, which consists of two hemispheres

cerebral cortex the wrinkled surface area (gray matter) of the cerebrum

corpus callosum a thick fiber bundle that connects the hemispheres of the cortex

somatosensory cortex the section of cortex in which sensory stimulation is projected; it lies just behind the central fissure in the parietal lobe

motor cortex the section of cortex that lies in the frontal lobe, just across the central fissure from the sensory cortex; neural impulses in the motor cortex are linked to muscular responses throughout the body

2-5a THE STRUCTURE OF THE CEREBRAL CORTEX

The cerebral cortex has two hemispheres, left and right. Each of the hemispheres is divided into four lobes, as shown in Figure 2.10. The *frontal lobe* lies in front of the central fissure and the *parietal lobe* behind it.

The *temporal lobe* lies below the side, or lateral, fissure—across from the frontal and parietal lobes. The *occipital lobe* lies behind the temporal lobe and behind and below the parietal lobe.

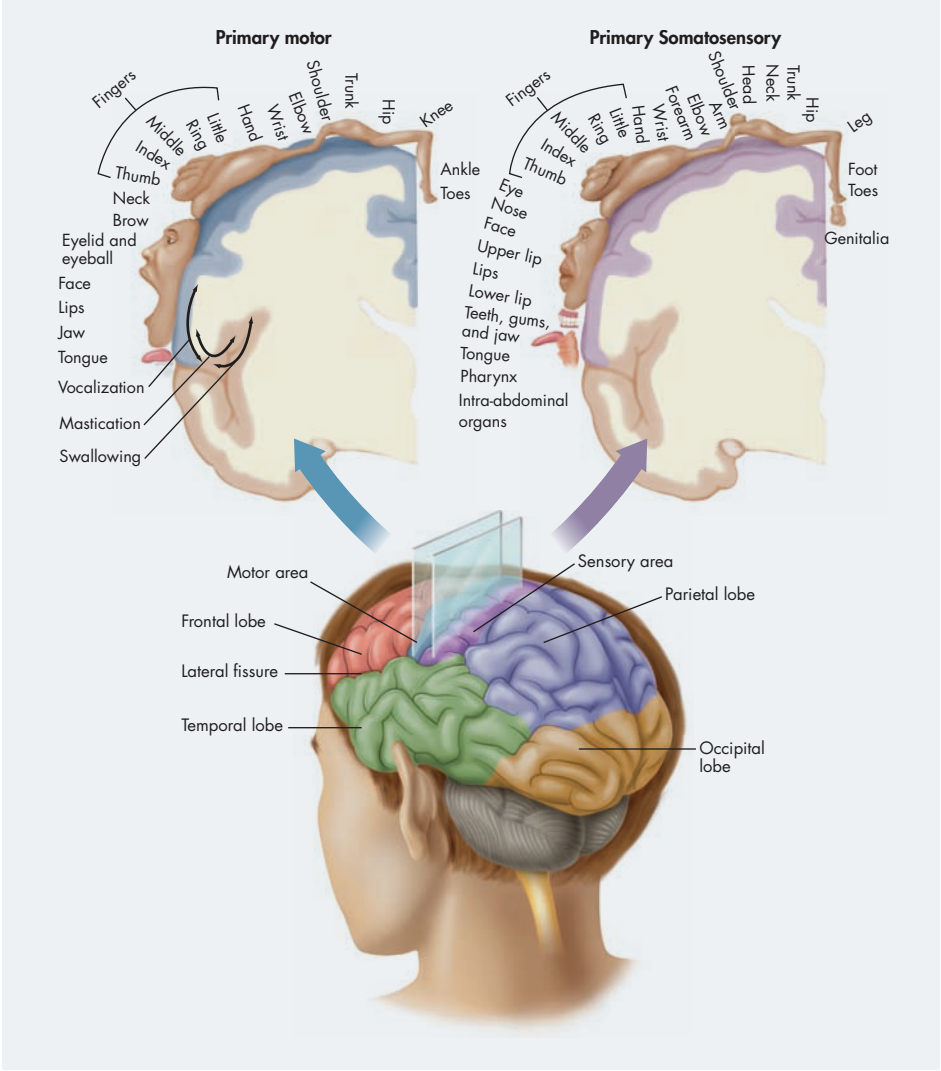
When light strikes the eyes, neurons in the occipital lobe fire and, as a result, we "see" (i.e., the image is projected in the brain). Direct artificial stimulation of the occipital lobe also produces visual sensations. If neurons in the occipital region of the cortex were stimulated with electricity, you would "see" flashes of light even if it were pitch-black or your eyes were covered. The hearing or auditory area of the cortex lies in the temporal lobe along the lateral fissure. Sounds cause structures in the ear to vibrate. Messages are relayed from those structures to the auditory area of the cortex; when you hear a noise, neurons in this area are firing.

Just behind the central fissure in the parietal lobe lies a sensory area called the **somatosensory cortex**, which receives messages from skin senses all over the body. These sensations include warmth and cold, touch, pain, and movement. Neurons in different parts of the sensory cortex fire, depending on whether you wiggle your finger or raise your leg.

Many years ago it was discovered that patients with injuries to one hemisphere of the brain would show sensory or motor deficits on the opposite side of the body below the head. This led to the recognition that sensory and motor nerves cross in the brain and elsewhere. The left hemisphere controls, acts on, and receives inputs from the right side of the body. The right hemisphere controls, acts on, and receives inputs from the left side of the body. The motor area of the cerebral cortex, or **motor cortex**, lies in the frontal lobe, just across the valley of the central fissure from the somatosensory cortex. Neurons firing in the motor cortex cause parts of our body to move. More than 100 years ago, German scientists electrically stimulated the motor cortex in dogs and observed that muscles contracted in response (Fritsch & Hitzig, 1870/1960). Since then, neuroscientists have mapped the motor cortex in people and lower animals by inserting electrical probes and seeing which muscles contract. For example, José Delgado (1969) caused one patient to make a fist even though he tried to prevent his hand from closing. The patient said, "I guess, doctor, that your electricity is stronger than my will" (p. 114).

> The cerebral cortex frees people from the tyranny of genetic dictates and instinct.

FIG. 2.10 THE GEOGRAPHY OF THE CEREBRAL CORTEX



The cortex has four lobes: frontal, parietal, temporal, and occipital. The visual area of the cortex is in the occipital lobe. The hearing or auditory cortex lies in the temporal lobe. The motor and somatosensory areas face each other across the central fissure. Note that the face and the hands are "supersized" in the motor and somatosensory areas. Why do you think this is so?

2-5b THINKING, LANGUAGE, AND THE CEREBRAL CORTEX

Areas of the cerebral cortex that are not primarily involved in sensation or motor activity are called *association areas*. They make possible the breadth and depth of human learning, thought, memory, and language. The association areas in the *prefrontal* region of the brain—that is, in the frontal lobes, near the forehead—are the brain's executive center, where we solve problems and make plans and decisions.

Executive functions like problem solving also require memory, like the memory in your computer. Association areas also provide the core of your working memory (Goriounova & Mansvelder, 2019). They are connected with various sensory areas in the brain and can tap whatever sensory information is needed or desired. The prefrontal region thus retrieves visual, auditory, and other memories and manipulates them; similarly, a computer retrieves information from files in storage and manipulates it in working memory.

Certain neurons in the visual area of the occipital lobe fire in response to the visual presentation of vertical lines. Others fire in response to presentation of horizontal lines. Although one group of cells may respond to one aspect of the visual field and another group of cells may respond to another, association areas put it all together. As a result, we see a box, an automobile, or a road map and not a confusing array of verticals and horizontals.

LANGUAGE FUNCTIONS In some ways, the left and right hemispheres of the brain duplicate each other's functions. In other ways, they differ. The left hemisphere contains language functions for nearly all right-handed

TRUTH

It is **true** that if a certain part of your brain—in your somatosensory cortex—were stimulated with an electrical probe, it might seem to you as if someone is touching your arm or leg. The actual source of the stimulation might be unclear to you.