CHAPTER 1

LumiNola/E+/Getty Images

Thinking Critically With Psychological Science (Modules 1–3)

Astronomer Owen Gingerich has described the human brain as "by far the most complex physical object known to us in the entire cosmos" (2006, p. 29). On the scale of outer space, we are less than a single grain of sand on all the oceans' beaches, and our lifetime lasts but a relative nanosecond. Yet there is nothing more awe inspiring than our own inner space. Our consciousness—our mind somehow arising from matter—remains a profound mystery. Our thinking, emotions, and actions (and their interplay with others' thinking, emotions, and actions) fascinate us. Outer space staggers us with its enormity. But inner space enthralls us. Enter psychological science.

From news and media portrayals, you might think that psychologists offer counseling, analyze personality, dispense child-raising advice, examine crime scenes, and testify in court. Do they? *Yes*—and much more. Consider some of psychology's questions that you may wonder about:

- Have you ever worried about how to act among people of a different cultural tradition, gender identity, or sexual orientation, or among people with differing abilities? *How are we alike as members of the human family? How do we differ?*

1 The History and Scope of Psychology
- Psychology Is a Science
- **THINKING CRITICALLY ABOUT:** The Scientific Attitude
- Critical Thinking
- Psychological Science Is Born
- Psychological Science Matures
- Contemporary Psychology
- Use Psychology to Become a Stronger Person—and a Better Student

2 Research Strategies: How Psychologists Ask and Answer Questions
- The Need for Psychological Science
- Psychological Science in a Post-Truth World
- The Scientific Method
- **THINKING CRITICALLY ABOUT:** Correlation and Causation
- Psychology's Research Ethics

3 Statistical Reasoning in Everyday Life
- Statistical Literacy
- Descriptive Statistics
- Inferential Statistics

- Have you ever vowed to *never* react as one of your biological parents would—but find yourself doing so anyway—and then wondered how much of your personality you inherited? *To what extent do genes predispose our individual differences in personality? How do home and community environments shape us?*
- Have you ever awakened from a nightmare and wondered why you had such a crazy dream? *Why do we dream? Why is sleep so important?*
- Have you ever played peekaboo with a 6-month-old and wondered why the baby finds your disappearing/reappearing act so delightful? *What do babies perceive and think?*
- Have you ever wondered what fosters school and work success? *Does inborn intelligence explain why some people get richer, think more creatively, or relate more sensitively? Or does gritty effort, and a belief in the power of persistence, matter more?*
- Have you ever become depressed or anxious and wondered when, or if, it will pass? *What affects our emotional well-being? What's the line between feeling "off" and a psychological disorder?*

As we will see in Modules 1 and 2, psychology is a science that seeks to answer such questions about us all—how and why we think, feel, and act as we do.

MODULE 1

The History and Scope of Psychology

Once upon a time, on a planet in our neighborhood of the universe, there came to be people. Soon thereafter, these creatures became intensely interested in themselves and in one another: "Who are we? What produces our thoughts? Our feelings? Our actions? And how are we to understand and interact with those around us?"

Psychology Is a Science

LEARNING OBJECTIVE QUESTION LOQ 1-1 How is psychology a science?

To assist your learning, numbered *Learning Objective Questions* appear at the beginning of major sections. You can test your understanding by trying to answer the question before, and then again after, you read the section.

Throughout the text, the most important concepts are boldfaced, with definitions immediately available (and in the Glossary at the end of the book).

Underlying all science is, first, a passion for exploring and understanding without misleading or being misled. Some questions *(Is there life after death?)* are beyond science. Answering them in any way requires a leap of faith. With many other ideas *(Can some people demonstrate extrasensory perception [ESP]?)*, the proof is in the pudding. We can let the facts speak for themselves.

Magician James Randi used an **empirical approach** when testing those claiming to see glowing auras around people's bodies:

Randi: Do you see an aura around my head?

Aura seer: Yes, indeed.

Randi: Can you still see the aura if I put this magazine in front of my face?

Aura seer: Of course.

Randi: Then if I were to step behind a wall barely taller than I am, you could determine my location from the aura visible above my head, right?

Randi once told me [DM] that no aura seer had yet agreed to take this simple test.

No matter how sensible-seeming or how wild an idea, the smart thinker asks: *Does it work?* When put to the test, do the data support its predictions? Subjected to scrutiny, crazy-sounding ideas sometimes find support.

More often, science becomes society's garbage disposal. It sends crazy-sounding ideas to the waste heap, atop previous claims of miracle cancer cures and out-of-body travels

empirical approach an evidence-based method that draws on observation and experimentation.

into centuries past. To sift reality from fantasy and fact from fiction therefore requires a *scientific attitude:* being skeptical but not cynical, open-minded but not gullible. When ideas compete, careful testing can reveal which ones best fit the facts. Do some people have a psychic power to predict an unexpected catastrophe? Is *electroconvulsive therapy* (delivering an electric shock to the brain) an effective treatment for severe depression? As we will see, putting such claims to the test has led psychological scientists to answer *No* to the first question and *Yes* to the second.

Putting a scientific attitude into practice requires not only curiosity and skepticism but also *humility*—awareness of our vulnerability to error and an openness to new perspectives. What matters is not my opinion or yours, but the truths revealed by our questioning and testing. If people or other animals don't behave as our ideas predict, then so much the worse for our ideas—and so much the better for scientific progress. One of psychology's early mottos expressed this humble attitude: "The rat is always right." (See Thinking Critically About: The Scientific Attitude.)

Humility predicts helpfulness and realistic academic confidence (Erlandsson et al., 2018). One nine-country study asked 40,000 teens which of 16 math concepts were familiar to them. The teens didn't realize that the researchers had inserted three fake terms: "proper number," "subjective scaling," and "declarative fraction." Those who arrogantly claimed to know the nonexistent concepts were often men from advantaged backgrounds (Jerrim et al., 2019). *The point to remember:* Knowing what we *don't* know enables generosity and intellectual humility, which in turn supports a healthy democracy. "Democratic citizenship," notes psychologist Fathali Moghaddam (2019), begins by "accepting that 'I could be wrong,' 'I must critically question everything' ... and 'I must revise my opinions as the evidence requires.'"

Throughout the book, information sources are cited in parentheses, with researchers' names and the date the research was published. For example, see "(Erlandsson et al., 2018)". Every citation can be found in the end-of-book References section, with complete documentation that follows American Psychological Association (APA) style.

ASK YOURSELF

Were you surprised to learn that psychology is a science? How would you explain that now if someone asked you about it?

Critical Thinking

LOQ 1-3 How does critical thinking feed a scientific attitude, and smarter thinking for everyday life?

The scientific attitude—curiosity + skepticism + humility—prepares us to think smarter. This smart thinking, called **critical thinking**, examines assumptions, appraises the source, discerns hidden biases, evaluates evidence, and assesses conclusions. When reading a research report, an online opinion, or a news story, critical thinkers ask questions: *How do they know that? What is this person's agenda? Is the conclusion based on anecdote, or evidence? Does the evidence justify a cause-effect conclusion? What alternative explanations are possible?*

From a tongue-in-cheek Twitter feed: "The problem with quotes on the internet is that you never know if they're true." — Abraham Lincoln

Critical thinkers wince when people make factual claims based on their gut: "I *feel like* climate change is [or isn't] happening." "I *feel like* self-driving cars are more [or less] dangerous." "I *feel like* I'm safe from Covid here." Such beliefs (commonly mislabeled as feelings) may or may not be true. Critical thinkers realize that they might be wrong. Sometimes, the best evidence confirms our beliefs. Other times it beckons us to a different way of thinking. Cynics sometimes seem smart, yet most demonstrate less cognitive ability and academic competence than average (Stavrova & Ehlebracht, 2019). To believe everything—or to reject everything—is to be a fool. Critical thinking, informed by science, helps check our biases. Consider: Does climate change threaten our future, and, if so, is it human-caused? Some climate-action advocates have interpreted record flooding as proof of climate change. Some climate-change skeptics have perceived a single colder-than-average winter as discounting global warming. Rather than having their understanding of climate change swayed by local weather examples, critical thinkers say, "Show me the evidence." Over time, is the Earth actually warming? Are the polar ice

critical thinking thinking that does not automatically accept arguments and conclusions. Rather, it examines assumptions, appraises the source, discerns hidden biases, evaluates evidence, and assesses conclusions.

Thinking Critically About:

The Scientific Attitude

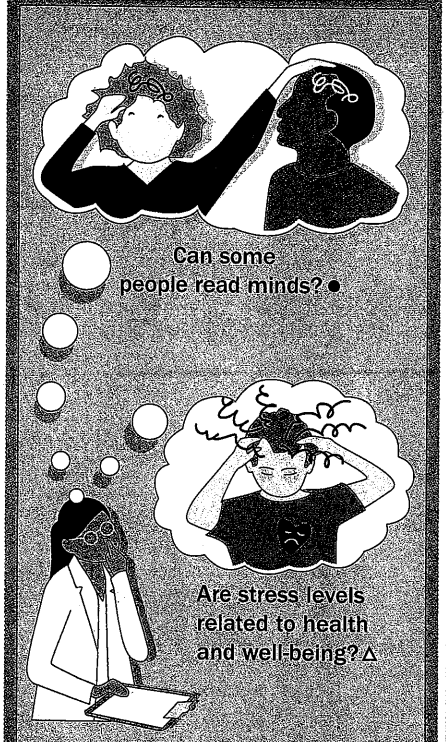
LOQ 1-2 What are the three key elements of the scientific attitude, and how do they support scientific inquiry?

Three basic attitudes helped make modern science possible.

1 CURIOSITY:

Does it work?

When put to the test, can its predictions be confirmed?



● *No one has yet been able to demonstrate extrasensory mind reading.*

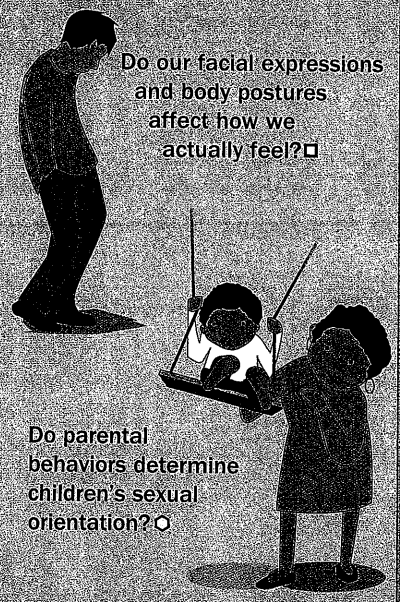
△ *Many studies have found that higher stress relates to poorer health.*

2 SKEPTICISM:

What do you mean?

How do you know?

Sifting reality from fantasy requires a healthy skepticism—an attitude that is not cynical (doubting everything), but also not gullible (believing everything).



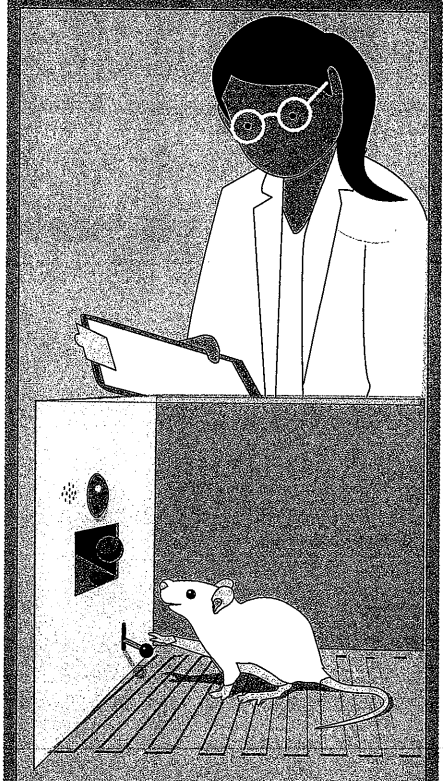
□ *Our facial expressions and body postures can affect how we feel.*

○ *Module 34 explains that there is not a relationship between parental behaviors and children's sexual orientation.*

3 HUMILITY:

That was unexpected! Let's explore further.

Researchers must be willing to be surprised and follow new ideas. People and other animals don't always behave as our ideas and beliefs would predict.



The rat is always right.

caps melting? Are vegetation patterns changing? Are extreme weather events becoming more frequent? And is human activity emitting atmospheric CO_2 that would lead us to expect such changes?

When contemplating such issues, critical thinkers will also consider the credibility of sources. They will look at the evidence (*Do the facts support them, or are they just makin' stuff up?*). They will recognize multiple perspectives. And they will expose themselves to news sources that challenge their preconceived ideas.

Some religious people may view critical thinking and scientific inquiry, including psychology's, as a threat. Yet many leaders of the scientific revolution, including Copernicus and Newton, were deeply religious people. U.S. astronomer Carl Sagan (1979) noted,

> My deeply held belief is that if a god anything like the traditional sort exists, our curiosity and intelligence are provided by such a god. We would be unappreciative of those gifts ... if we suppressed our passion to explore the universe and ourselves.

Critical inquiry can surprise us. Some examples from psychological science: Massive losses of brain tissue early in life may have minimal long-term effects (see Module 6). Within days, newborns can recognize their mother's odor (see Module 15). After brain damage, a person may be able to learn new skills yet be unaware of such learning (see Module 25). People of differing ages, genders, and abilities report roughly comparable levels of personal happiness (see Module 38). Depression touches many people, but most recover (see Module 50).

Other modules also illustrate how critical inquiry sometimes debunks popular presumptions, by checking intuitive fiction with empirical fact: Sleepwalkers are *not* acting out their dreams (see Module 9). Our past experiences are *not* all recorded verbatim in our brain. With brain stimulation or hypnosis, one *cannot* merely replay and relive long-buried or repressed memories (see Module 26). Opposites tend *not* to attract (see Module 44). Most people do *not* suffer from unrealistically low self-esteem, and high self-esteem is *not* all good (see Module 47). In these instances and many more, what psychological scientists have learned is not what is widely believed.

Psychology's critical inquiry can also identify effective policies. To deter crime, should we invest money in lengthening prison sentences, or should we increase the likelihood of arrest? To help people recover from a trauma, should counselors help them relive it, or not? To increase voting, should we tell people about the low turnout problem, or emphasize that their peers are voting? What matters is not what we "feel" is true, but what is true. When put to critical thinking's test—and contrary to common practice—the second option in each case wins (Shafir, 2013). Thinking critically can—and sometimes does—change the world.

Critical thinking can also change us, by helping us assess popular applications of psychology. Looking at a self-help blog, we can consider the author's expertise and goals. We can ask: Are the suggestions based on evidence or anecdote? And how might the author's personal values and agenda affect the advice? If you defer to guidance about how to live—how to raise children, how to achieve self-fulfillment, how to respond to sexual feelings, how to get ahead at work—you are accepting value-laden advice. A science of behavior and mental processes can help us reach our goals. But it cannot decide which goals are worth pursuing. Psychological scientists teach, but they do not preach.

Study Tip: Memory research reveals a *testing effect:* We retain information much better if we actively retrieve it by self-testing and rehearsing. (More on this at the end of this module.) To bolster your learning and memory, take advantage of the *Retrieval Practice* opportunities you'll find throughout this text—with answers for checking in Appendix E, or a click away in the e-book.

RETRIEVAL PRACTICE

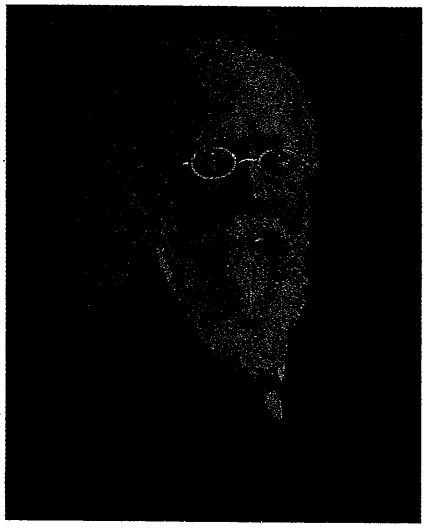
RP-1 Describe what's involved in critical thinking.

ANSWERS IN APPENDIX E

Psychological Science Is Born

LOQ 1-4 What were some important milestones in psychology's early history?

To be human is to be curious about ourselves and the world around us. Before 300 B.C.E., the Greek naturalist and philosopher Aristotle theorized about learning and memory, motivation and emotion, perception and personality. Today we chuckle at some of his guesses, such as his suggestion that a meal makes us sleepy by causing gas and heat to collect around the supposed source of our personality, the heart. But credit Aristotle with asking the right questions.



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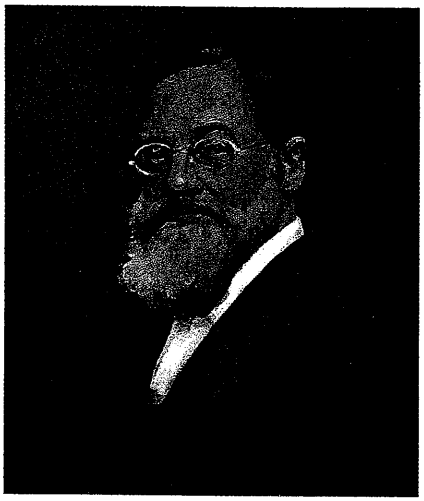
Wilhelm Wundt (1832–1920) Wundt established the first psychology laboratory at the University of Leipzig, Germany.



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Edward Bradford Titchener (1867–1927) Titchener used introspection to search for the mind's structural elements.

Psychology's First Laboratory

Philosophers' thinking about thinking continued until the birth of psychology's first laboratory. On a December day in 1879, in a small, third-floor room at Germany's University of Leipzig, two graduate students helped an austere, middle-aged professor, Wilhelm Wundt, create an experimental apparatus. Their machine measured how long it took for people to press a telegraph key after hearing a ball hit a platform (Hunt, 1993). Curiously, people responded in about one-tenth of a second when asked to press the key as soon as the sound occurred—and in about two-tenths of a second when asked to press the key as soon as they were consciously aware of perceiving the sound. (To be aware of one's awareness takes a little longer.) Wundt wanted to measure "atoms of the mind"—the fastest and simplest mental processes.

Psychology's First Schools of Thought

Before long, this new science of psychology became organized into different branches, or schools of thought, each promoted by pioneering thinkers. Two early schools were **structuralism** and **functionalism**.

STRUCTURALISM Much as chemists developed the periodic table to classify chemical elements, so psychologist Edward Bradford Titchener aimed to classify and understand elements of the mind's structure (structuralism). He engaged people in self-reflective *introspection* (looking inward), training them to report elements of their experience as they looked at a rose, listened to a metronome, smelled a scent, or tasted a substance. What were their immediate sensations, their images, their feelings? And how did these relate to one another? Alas, structuralism's technique of introspection proved somewhat unreliable. It required smart, verbal people, and its results varied from person to person and experience to experience. As introspection waned, so did structuralism. Hoping to assemble the mind's structure from simple elements was rather like trying to understand a smartphone by examining its disconnected parts.

FUNCTIONALISM Philosopher-psychologist William James sought to go beyond labeling our inner thoughts and feelings by considering their evolved *functions* (functionalism). Smelling is what the nose does; thinking is what the brain does. But *why* do the nose and brain do these things? Under the influence of evolutionary theorist Charles Darwin, James assumed that thinking, like smelling, developed because it was *adaptive*—it helped our ancestors survive and reproduce. Consciousness serves a function. It enables us to consider our past, adjust to our present, and plan our future. To explore the mind's adaptive functions, James studied emotions, memories, willpower, habits, and moment-to-moment *stream of consciousness* thinking.

James' writings moved the publisher Henry Holt to offer James a contract for a textbook on the new science of psychology. James agreed and began work in 1878, with an apology for requesting two years to finish his writing. The text proved an unexpected chore and actually took him 12 years. (Why are we authors not surprised?) More than a century later, people still read the resulting *Principles of Psychology* (1890) and marvel at the brilliance and elegance with which James introduced psychology to the educated public.

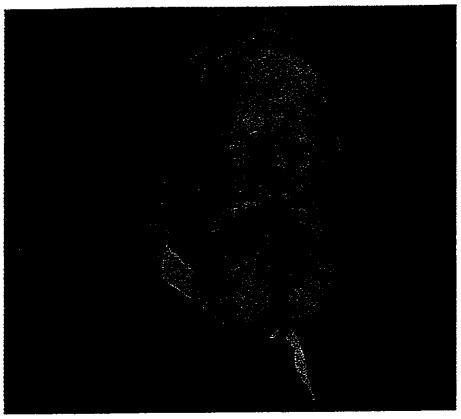
Psychology's First Women

James' legacy stems from his Harvard mentoring as well as from his writing. In 1890—thirty years before U.S. women had the right to vote—he admitted Mary Whiton Calkins into his graduate seminar over the objections of Harvard's president (Scarborough & Furumoto, 1987). When Calkins joined, the other students (all men) dropped out. So, James tutored her alone. Later, she finished all of Harvard's Ph.D. requirements, outscoring all the male students on the qualifying exams. Alas, Harvard denied her the degree she had earned, offering her instead a doctorate from Radcliffe College, its undergraduate "sister" school for women. Calkins resisted the unequal treatment and refused the degree. She nevertheless went on to become a distinguished memory researcher and, in 1905, the first female president of the American Psychological Association (APA).

The honor of being the first official female psychology Ph.D. later fell to Margaret Floy Washburn, who also wrote an influential book, *The Animal Mind*. In 1921, Washburn became the second female APA president (Fragaszy, 2021). But Washburn's gender barred

structuralism an early school of thought promoted by Wundt and Titchener; used introspection to reveal the structure of the human mind.

functionalism an early school of thought promoted by James and influenced by Darwin; explored how mental and behavioral processes function—how they enable the organism to adapt, survive, and flourish.



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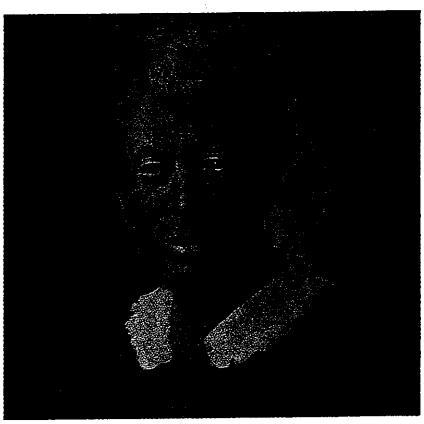

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William James (1842–1910) and Mary Whiton Calkins (1863–1930) James was a legendary teacher-writer who authored an important psychology text. He mentored Calkins, a memory researcher who would become the first female president of the American Psychological Association.

Macmillan Learning

Margaret Floy Washburn (1871–1939) The first woman to receive a psychology Ph.D., Washburn synthesized animal behavior research in *The Animal Mind* (1908).

doors for her, too. Although her thesis was the first foreign study Wundt published in his psychology journal, she could not join the all-male organization of experimental psychologists founded by Titchener, her own graduate adviser (Johnson, 1997). What a different world from the recent past: Between 1997 and 2021, more than half of the elected presidents of the science-focused Association for Psychological Science (APS) were women. In the United States, Canada, and Europe, women now earn most psychology doctorates. Nevertheless, a gender gap persists in publishing psychological research in top journals, promotion to senior professorships, and salary (Gruber et al., 2021).

1964 meeting of the Society of Experimental Psychologists in Berkeley, California. Reprinted by permission of the Society of Experimental Psychologists. http://www.sepsych.org/1964.php

(a)

Gordon B. Moskowitz, professor in Lehigh's Department of Psychology

(b)

Psychology's increasing diversity At this 1964 meeting of the Society of Experimental Psychologists (a), Eleanor Gibson was easy to spot among the many male members, all in a sea of White faces. By contrast, women are now 61 percent of APS members, including 75 percent of its psychology student affiliates, as is clear in this recent photo of APS graduate students (b). People of color have made enormous contributions to the field (see, for example, coverage of Mamie Phipps Clark and Kenneth Clark in the Chapter 1 modules), and psychology's diversity continues to grow—with one-third of recent psychology doctorates earned by people of color (APA, 2021). For more on the history of these changes, see Appendix A, the Story of Psychology: A Timeline.

behaviorism the view that psychology (1) should be an objective science that (2) studies behavior without reference to mental processes. Most psychologists today agree with (1) but not with (2).

ASK YOURSELF

How do you think psychology might change in the future as more women, and others from historically excluded groups, contribute their ideas to the field?

RETRIEVAL PRACTICE

RP-2 What event defined the start of scientific psychology?

RP-3 Why did introspection fail as a method for understanding how the mind works?

RP-4 The school of _____ used introspection to define the mind's makeup; _____ focused on how mental processes enable us to adapt, survive, and flourish.

ANSWERS IN APPENDIX E

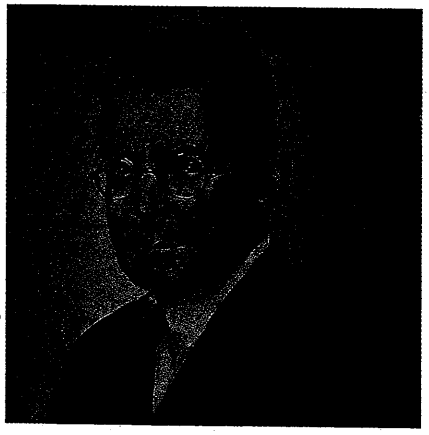
Psychological Science Matures

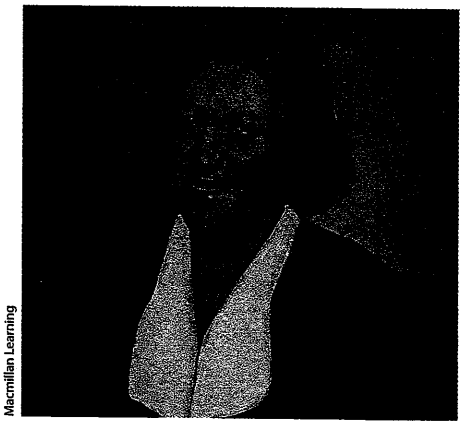
LOQ 1-5 How did behaviorism, Freudian psychology, and humanistic psychology further the development of psychological science?

Many early psychologists shared English essayist C. S. Lewis's view that "there is one thing, and only one in the whole universe which we know more about than we could learn from external observation." That one thing, Lewis said, is ourselves. "We have, so to speak, inside information" (1960, pp. 18–19). Wundt and Titchener focused on inner sensations, images, and feelings. James also engaged in introspective examination of the stream of consciousness and of emotion, hoping to understand how they help humans survive and thrive. For these and other early pioneers, *psychology* was defined as "the science of mental life."

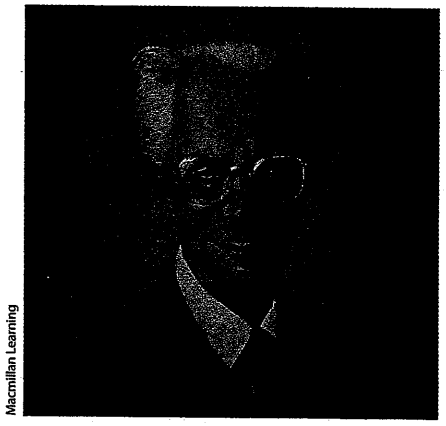
Behaviorism

In the 1920s, provocative U.S. psychologists began to challenge the definition of psychology as the "science of mental life." John B. Watson and, later, B. F. Skinner dismissed introspection and redefined *psychology* as "the scientific study of observable behavior." After all, they said, science is rooted in observation: What you cannot observe and measure, you cannot scientifically study. You cannot observe a sensation, a feeling, or a thought, but you *can* observe and record people's *behavior* as they are *conditioned*—as they respond to and learn in different situations. Many agreed, and **behaviorism** was increasingly influential well into the 1960s (Braat et al., 2020).





John B. Watson (1878–1958) and Rosalie Rayner (1898–1935) Working with Rayner, Watson championed psychology as the scientific study of behavior. In a controversial study on a baby who became famous as "Little Albert," he and Rayner showed that fear could be learned. (More about this in the Learning modules.)



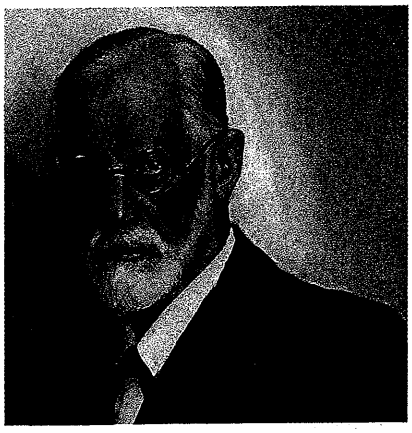
B. F. Skinner (1904–1990) This leading behaviorist rejected introspection and studied how consequences shape behavior.

Freudian (Psychoanalytic) Psychology

Another major force in psychology's development was Sigmund Freud's *psychoanalytic psychology*, which emphasized the ways our unconscious mind and childhood experiences affect our behavior. (In other modules, we'll look more closely at Freud's ideas, including his theory of personality, and his views on unconscious sexual conflicts and the mind's defenses against its own wishes and impulses.)

Humanistic Psychology

As the behaviorists had rejected the early twentieth-century definition of *psychology*, other groups rejected the behaviorist definition. In the 1960s, **humanistic psychologists**, led by Carl Rogers and Abraham Maslow, found both behaviorism and Freudian psychology too limiting. Rather than focusing on conditioned responses or childhood memories, the humanistic psychologists focused on our growth potential, our needs for love and acceptance, and the environments that nurture or limit personal growth.



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Sigmund Freud (1856–1939) The controversial ideas of this famed personality theorist and therapist have influenced humanity's self-understanding.

RETRIEVAL PRACTICE

RP-5 From the 1920s until the 1960s, the two major forces in psychology were _____ and _____ psychology.

ANSWERS IN APPENDIX E

Contemporary Psychology

LOQ 1-6 How has contemporary psychology focused on cognition, on biology and experience, on culture and gender, and on human flourishing?

Simultaneous with humanistic psychology's emergence, psychologists in the 1960s pioneered a *cognitive revolution*, which led the field back to its early interest in how our mind processes and retains information. **Cognitive psychology** today continues its scientific exploration of how we perceive, process, and remember information, and of how thinking and emotion interact in anxiety, depression, and other disorders. The marriage of cognitive psychology (mind science) and neuroscience (brain science) gave birth to **cognitive neuroscience**. This specialty, with researchers in many disciplines, studies the brain activity underlying mental activity.

Today's psychology builds on the work of many earlier scientists and schools of thought. To encompass psychology's concern with observable behavior *and* with inner thoughts and feelings, we now define **psychology** as the *science of behavior and mental processes*. Let's unpack this definition. *Behavior* is anything an organism *does*—any action we can observe and record. Yelling, smiling, blinking, sweating, talking, tweeting, and questionnaire marking are all observable behaviors. *Mental processes* are our internal, subjective experiences—our sensations, perceptions, dreams, thoughts, beliefs, and feelings.

The key word in today's definition of psychology is *science*. Psychology is less a set of findings than a way of asking and answering questions. Our aim, then, is not merely to report results but also to show you how psychologists play their game. You will see how researchers evaluate conflicting opinions and ideas. And you will learn how all of us, whether scientists or simply curious people, can think harder and smarter when experiencing and explaining the events of our lives.

Psychology—the science of behavior and mental processes—has roots in many disciplines and countries. The young science of psychology developed from the more established fields of philosophy and biology. Wundt was a German philosopher and a physiologist. James was an American philosopher. Freud was an Austrian physician. Ivan Pavlov (Learning modules), who pioneered the study of learning, was a Russian physiologist. Jean Piaget (Developing Through the Life Span modules), the last century's most influential scientific observer of children, was a Swiss biologist.

humanistic psychology a historically significant perspective that emphasized human growth potential.

cognitive psychology the study of the mental processes involved in perceiving, learning, remembering, thinking, communicating, and solving problems.

cognitive neuroscience the interdisciplinary study of the brain activity linked with cognition (perception, thinking, memory, and language).

psychology the science of behavior and mental processes.

nature–nurture issue the longstanding controversy over the relative contributions that genes and experience make to the development of psychological traits and behaviors. Today's science sees traits and behaviors arising from the interaction of nature and nurture.

natural selection the principle that the inherited traits enabling an organism to survive and reproduce in a particular environment will (in competition with other trait variations) most likely be passed on to succeeding generations.

evolutionary psychology the study of the evolution of behavior and the mind, using principles of natural selection.

behavior genetics the study of the relative power and limits of genetic and environmental influences on behavior.

Like those pioneers, today's estimated 1+ million psychologists are citizens of many lands (Zoma & Gielen, 2015). The International Union of Psychological Science has 89 member nations, from Albania to Zimbabwe. In China, the first university psychology department was established in 1978; by 2016 there were 270 (Zhang, 2016). Psychology is both *growing* and *globalizing*. The story of psychology is being written in many places, with interests ranging from the study of nerve cell activity to the study of international conflicts. Contemporary psychology, shaped by many forces, is particularly influenced by our understanding of biology and experience, culture and gender, and human flourishing.

ASK YOURSELF

How would you have defined *psychology* before taking this class?

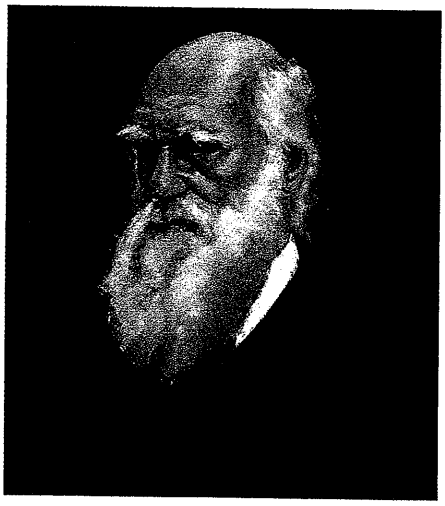
Evolutionary Psychology and Behavior Genetics

Are our human traits inherited, or do they develop through experience? This has been psychology's biggest and most persistent issue. But the debate over the **nature–nurture issue** is ancient. The Greek philosopher Plato (428–348 B.C.E.) assumed that we inherit character and intelligence and that certain ideas are inborn. Aristotle (384–322 B.C.E.) countered that there is nothing in the mind that does not first come in from the external world through the senses.

In the 1600s, European philosophers rekindled the debate. John Locke argued that the mind is a blank slate on which experience writes. René Descartes disagreed, believing that some ideas are innate. Descartes' views gained support from a curious naturalist two centuries later. In 1831, an indifferent student but ardent collector of beetles, mollusks, and shells decided not to become a priest and instead set sail on a historic round-the-world journey. The 22-year-old voyager, Charles Darwin, pondered the incredible species variation he encountered, including tortoises on one island that differed from those on nearby islands. Darwin's *On the Origin of Species* (1859) explained this diversity by proposing the evolutionary process of **natural selection:** From among chance variations, nature selects traits that best enable an organism to survive and reproduce in a specific environment. Darwin's principle of natural selection—what philosopher Daniel Dennett (1996) has called "the single best idea anyone has ever had"—is still with us 160+ years later as biology's organizing principle. Evolution also has become an important principle for twenty-first-century psychology. This would surely have pleased Darwin, who believed his theory explained not only animal structures (such as a polar bear's white coat) but also animal behaviors (such as human mating and emotional expressions).

The nature–nurture issue recurs throughout this text as today's psychologists explore the relative contributions of biology and experience. They ask, for example: How are we humans *alike* because of our shared biology and evolutionary history? That's the focus of **evolutionary psychology**. And how do we individually *differ* because of our differing genes and environments? That's the focus of **behavior genetics**.

We can, for example, ask: Are gender differences biologically predisposed or socially constructed? Is children's grammar mostly innate or formed by experience? How are intelligence and personality differences influenced by heredity and by environment?



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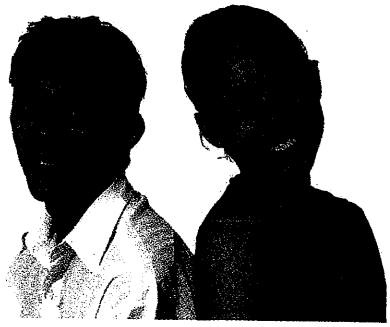
Charles Darwin (1809–1882) Darwin argued that natural selection shapes behaviors as well as bodies.

rubberball/Getty Images

A nature-made nature–nurture experiment Identical twins have the same genes. This makes them ideal participants in studies designed to shed light on hereditary and environmental influences on personality, intelligence, and other traits. Fraternal twins have different genes but often share a similar environment. Twin studies provide a wealth of findings—described in other modules—showing the importance of both nature and nurture.



© Tony Freeman/PhotoEdit

Are sexual behaviors more "pushed" by inner biology or "pulled" by external incentives? Should we treat psychological disorders—depression, for example—as disorders of the brain, disorders of thought, or both?

Repeatedly we will see that in contemporary science, the nature–nurture tension dissolves: *Nurture works on what nature provides.* In other modules, you'll learn about *epigenetics*—how experience can influence genetic expression. And you will see that our species has been graced with the tremendous biological gift of *neuroplasticity*—the brain's enormous capacity to learn and adapt. Moreover, every psychological event (every thought, every emotion) is simultaneously a biological event. Thus, depression can be both a brain disorder *and* a thought disorder.

culture the enduring behaviors, ideas, attitudes, values, and traditions shared by a group of people and transmitted from one generation to the next.

ASK YOURSELF

Think of one of your own traits. (For example, are you a planner or a procrastinator—do you usually complete assignments on time, or late? Are you more an extravert or introvert—do you become energized by social interactions, or recharge by spending time alone?) How do you think that trait was influenced by nature and nurture?

RETRIEVAL PRACTICE

RP-6 How did the cognitive revolution affect the field of psychology?

RP-7 What is natural selection?

RP-8 What is contemporary psychology's position on the nature–nurture issue?

ANSWERS IN APPENDIX E

Cross-Cultural and Gender Psychology

Participants in many studies have come from the WEIRD (Western, Industrial, Rich, and Democratic) cultures—so named because they represent a mere fraction of the people on our planet (Henrich, 2020). As we will see time and again, **culture**—shared ideas and behaviors that one generation passes on to the next—matters. Our culture shapes our standards of promptness and frankness, our attitudes toward relationships, our tendency to be casual or formal, our willingness to make eye contact, our hand gestures, and much, much more. By studying people from around the world, today's researchers have observed our individual and cultural differences—in personality, in expressiveness, in attitudes and beliefs.

"All people are the same; only their habits differ." — Confucius, 551–479 B.C.E.

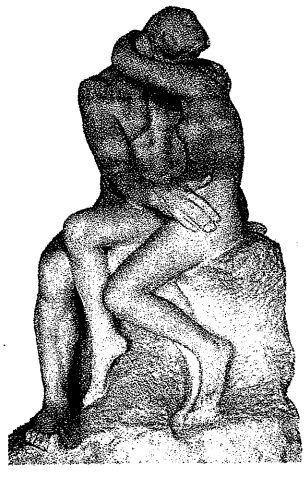
It is also true, however, that our shared biological heritage unites us as a universal human family. The same underlying processes guide people everywhere. Some examples:

- People diagnosed with *specific learning disorder* (formerly called dyslexia) exhibit the same brain malfunction, whether they are Italian, French, or British (Paulesu et al., 2001).
- Variation in languages may impede communication across cultures. Yet all languages share deep principles of grammar, and people from different corners of the world can communicate with a smile or a frown.
- People in different cultures vary in feelings of loneliness (Lykes & Kemmelmeier, 2014). But across cultures, loneliness is magnified by shyness and low self-esteem (Jones et al., 1985; Rokach et al., 2002).

We are each in certain respects like all others, like some others, and like no other. Studying people from all cultures helps us discern our similarities and our differences, our human kinship and our diversity.

Culture and kissing Kissing crosses cultures. Yet how we do it varies. Imagine yourself kissing someone on the lips. Do you tilt your head right or left? In Western cultures, where people read from left to right, about two-thirds of couples kiss right, as in Prince Harry and Duchess Meghan's wedding kiss and Auguste Rodin's sculpture, *The Kiss.* In one study, 77 percent of Hebrew- and Arabic-language right-to-left readers kissed tilting left (Shaki, 2013).

Jane Barlow/Getty Images



Hemis/Alamy Stock Photo

You will see throughout this book that our *gender identity*—our sense of being male, female, neither, or some combination of male and female—also matters, as does our biologically influenced *sex*. Today's researchers report gender differences in what we dream, in how we express and detect emotions, and in our risk for alcohol use disorder, depression, and eating disorders. Gender differences fascinate us, and studying them is potentially beneficial. For example, many researchers have observed that women carry on conversations more readily to build relationships, while men talk more to give information and advice (Tannen, 2001). Understanding these differences can help us prevent conflicts and misunderstandings in everyday interactions.

But again, psychologically as well as biologically, we are overwhelmingly similar. We learn to walk at about the same age. We experience the same sensations of light and sound. We remember vivid emotional events and forget mundane details. We feel the same pangs of hunger, desire, and fear. We exhibit similar overall intelligence and well-being.

The point to remember: Even when specific attitudes and behaviors vary by gender or across cultures, as they often do, the underlying processes are much the same.

Positive Psychology

Psychology's first hundred years often focused on understanding and treating troubles, such as abuse and anxiety, depression and disease, prejudice and poverty. Much of today's psychology continues the exploration of such challenges. Without slighting the need to repair damage and cure disease, Martin Seligman and others (2002, 2016) have called for more research on *human flourishing*—on understanding and developing the emotions and traits that help us to thrive. These psychologists call their approach **positive psychology**. They believe that happiness is a by-product of a pleasant, engaged, and meaningful life. Thus, positive psychology uses scientific methods to explore the building of a "good life" that engages our skills, and a "meaningful life" that points beyond ourselves.

Psychology's Three Main Levels of Analysis

LOQ 1-7 How do psychologists use the biopsychosocial approach, and how can it help us understand our diverse world?

We all share a biologically rooted human nature. Yet many psychological and social-cultural influences fine-tune our assumptions, values, and behavior. We differ individually by gender identity, physical ability, and sexual orientation. And each of us is a complex system that is part of a larger social system—family, ethnic group, culture, and *socioeconomic* status (combines education, income, and occupation). The **biopsychosocial approach** integrates these three **levels of analysis**—the biological, psychological, and social-cultural.

Consider horrific school shootings. Do they occur because the shooters have brain disorders or genetic tendencies that predispose them to violence? Because they have observed brutality in the media or played violent video games? Because they live in a gun-toting society? The biopsychosocial approach enables psychologists to move beyond labels ("school shooter") and to consider the interconnected factors that may lead to violent acts (Pryor, 2019) (**FIGURE 1.1**). Clinical psychologists use this approach to help people with mental disorders (Teachman et al., 2019).

Each level of analysis offers a perspective for looking at a behavior or mental process, yet each by itself is incomplete. Each perspective described in **TABLE 1.1** asks different questions and has its limits, but together they complement one another. Consider, for example, how they shed light on anger. Someone working from

- *a neuroscience perspective* might study brain circuits that cause us to be red in the face and "hot under the collar."
- *an evolutionary perspective* might analyze how anger facilitated the survival of our ancestors' genes.

positive psychology the scientific study of human flourishing, with the goals of discovering and promoting strengths and virtues that help individuals and communities to thrive.

biopsychosocial approach an integrated approach that incorporates biological, psychological, and social-cultural levels of analysis.

levels of analysis the differing complementary views, from biological to psychological to social-cultural, for analyzing any given phenomenon.

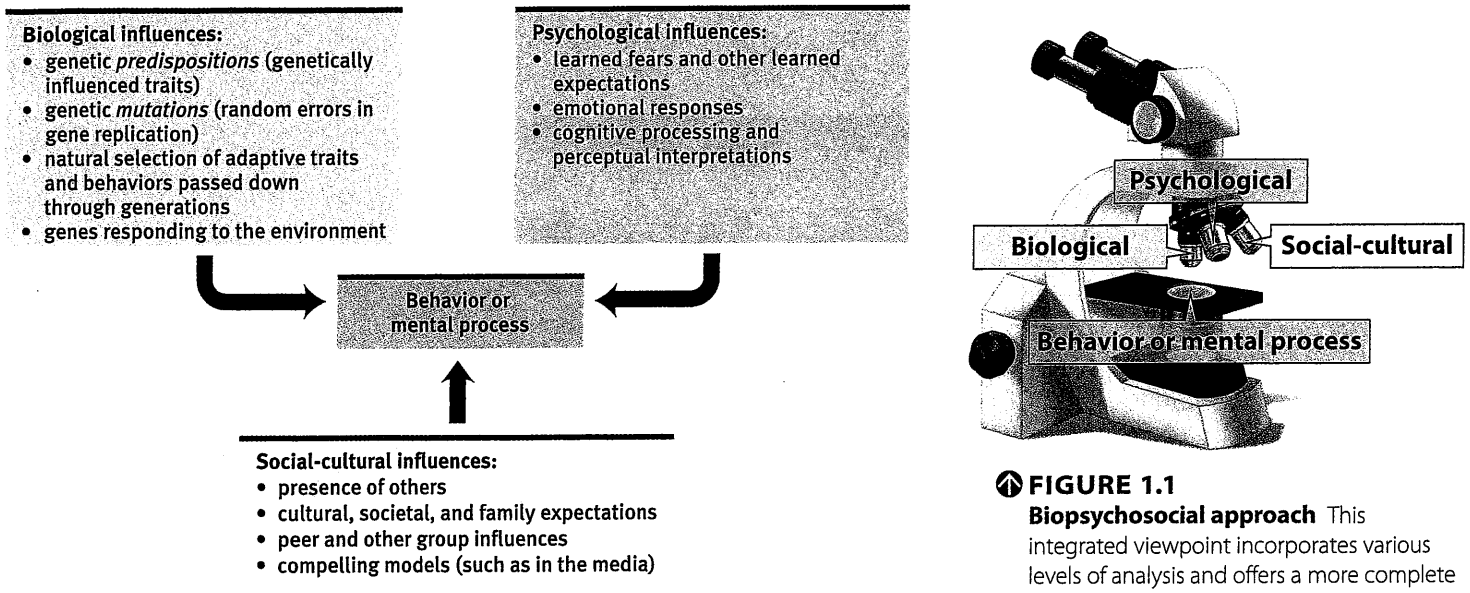


FIGURE 1.1
Biopsychosocial approach This integrated viewpoint incorporates various levels of analysis and offers a more complete picture of any given behavior or mental process.

- ***a behavior genetics perspective*** might study how heredity and experience influence our individual differences in temperament.
- ***a psychodynamic perspective*** might view an outburst as an outlet for unconscious hostility.
- ***a behavioral perspective*** might attempt to determine what triggers aggressive acts.
- ***a cognitive perspective*** might study how our interpretation of a situation affects our anger and how our anger affects our thinking.
- ***a social-cultural perspective*** might explore how expressions of anger vary across cultural contexts.

TABLE 1.1 Psychology's Theoretical Perspectives

Perspective	Focus	Sample Questions	Examples of Subfields Using This Perspective
Neuroscience	How the body and brain enable emotions, memories, and sensory experiences	How do pain messages travel from the hand to the brain? How is blood chemistry linked with moods and motives?	Biological; cognitive; clinical
Evolutionary	How the natural selection of traits has promoted the survival of genes	How does evolution influence behavior tendencies?	Biological; developmental; social
Behavior genetics	How our genes and our environment influence our individual differences	To what extent are psychological traits, such as intelligence, personality, sexual orientation, and vulnerability to depression, products of our genes? Of our environment?	Personality; developmental; legal/ forensic
Psychodynamic	How behavior springs from unconscious drives and conflicts	How can someone's personality traits and disorders be explained by unfulfilled wishes and childhood traumas?	Clinical; counseling; personality
Behavioral	How we learn observable responses	How do we learn to fear particular objects or situations? What is the most effective way to alter our behavior, say, to stop smoking?	Clinical; counseling; industrial-organizational
Cognitive	How we encode, process, store, and retrieve information	How do we use information in remembering? Reasoning? Solving problems?	Cognitive neuroscience; clinical; counseling; industrial-organizational
Social-cultural	How behavior and thinking vary across situations and cultures	How are we affected by the people around us, and by our surrounding culture?	Developmental; social; clinical; counseling

The point to remember: Like two-dimensional views of a three-dimensional object, each of psychology's perspectives is helpful. But each by itself fails to reveal the whole picture.

ASK YOURSELF

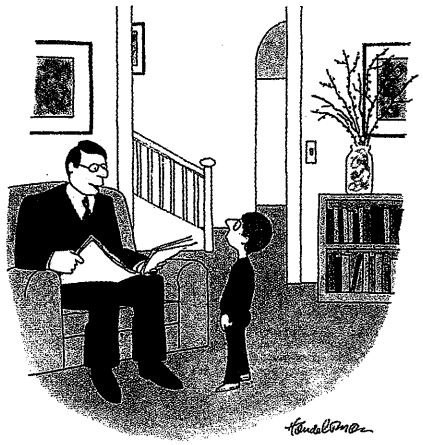
Which of psychology's theoretical perspectives do you find most interesting? Why?

RETRIEVAL PRACTICE

RP-9 What advantage do we gain by using the biopsychosocial approach in studying psychological events?

RP-10 The _____-_____ perspective in psychology focuses on how behavior and thought differ from situation to situation and from culture to culture, while the _____ perspective emphasizes observation of how we respond to and learn in different situations.

ANSWERS IN APPENDIX E



J.B. Handelsman/Cartoon Stock

"I'm a social scientist, Michael. That means I can't explain electricity or anything like that, but if you ever want to know about people I'm your man."

Psychology's Subfields

LOQ 1-8 What are psychology's main subfields?

Picturing a chemist at work, you may envision a laboratory scientist surrounded by test tubes and high-tech equipment. Picture a psychologist at work, and you would be right to envision

- a white-coated scientist probing a rat's brain.
- an intelligence researcher measuring how quickly an infant shows boredom by looking away from a familiar picture.
- an executive evaluating a new diversity and inclusion training program for employees.
- a researcher at a computer analyzing "big data" from social media status updates, online searches, or digital traces of people's behavior.
- a therapist actively listening to an anxious client's thoughts.
- an academic studying another culture and collecting data on variations in human values and behaviors.
- a teacher or writer sharing the joy of psychology with others.

The cluster of subfields we call psychology is a meeting ground for different disciplines. Thus, it's a perfect home for those with wide-ranging interests. In its diverse activities, from biological experimentation to cultural comparisons, the tribe of psychology is united by a common quest: *describing and explaining behavior and the mind underlying it.*

Some psychologists conduct **basic research** that builds psychology's knowledge base. We will meet a wide variety of such researchers, including *biological psychologists* exploring the links between body and mind; *developmental psychologists* studying our changing abilities from womb to tomb; *cognitive psychologists* experimenting with how we perceive, think, and solve problems; *personality psychologists* investigating our persistent traits; and *social psychologists* exploring how we view and affect one another.

These and other psychologists also may conduct **applied research**, tackling practical problems. *Industrial-organizational psychologists,* for example, use psychology's concepts and methods in the workplace to help organizations and companies select and train employees, boost morale and productivity, design products, and implement systems.

Psychology is a science, but it is also a profession that helps people have healthier relationships, overcome feelings of anxiety or depression, and raise thriving children. *Counseling psychology* and *clinical psychology* grew out of different historical traditions. Early counseling psychologists offered job skills guidance, whereas clinical psychologists worked alongside psychiatrists to assess and provide psychotherapy to people

basic research pure science that aims to increase the scientific knowledge base.

applied research scientific study that aims to solve practical problems.

counseling psychology a branch of psychology that assists people with problems in living (often related to school, work, or relationships) and in achieving greater well-being.

clinical psychology a branch of psychology that studies, assesses, and treats people with psychological disorders.

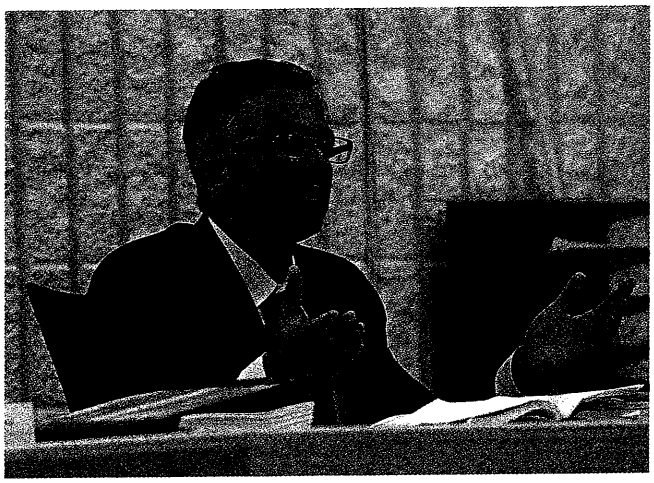
psychiatry a branch of medicine dealing with psychological disorders; practiced by physicians who provide medical (for example, drug) treatments as well as psychological therapy.

community psychology a branch of psychology that studies how people interact with their social environments and how social institutions (such as schools and neighborhoods) affect individuals and groups.

in the first psychology clinics. Today's counseling psychologists and clinical psychologists have a lot in common. **Counseling psychologists** help people to cope with challenges and crises (including academic, vocational, and relationship issues) and assist those with psychological disorders to improve their personal and social functioning. **Clinical psychologists** focus on assessing and treating people with mental, emotional, and behavior disorders. Both counseling and clinical psychologists administer and interpret tests, provide therapy and advice to people with all levels of psychological difficulties, and undergo licensing exams. They sometimes also conduct basic and applied research. By contrast, **psychiatrists**, who also may provide psychotherapy, are medical doctors licensed to prescribe drugs and otherwise treat physical causes of psychological disorders.

Rather than seeking to change people to fit their environment, **community psychologists** work to create social and physical environments that are healthy for all (Bradshaw et al., 2009; Trickett, 2009). To prevent bullying, for example, they might consider ways to improve the culture of a school and neighborhood, and how to increase bystander intervention (Polanin et al., 2012).

With perspectives ranging from the biological to the social, and with settings ranging from the laboratory to the clinic to the office, psychology relates to many fields. Psychologists teach in medical schools, business schools, law schools, and theological seminaries. They work in hospitals, factories, and corporate offices. And they engage in interdisciplinary studies, such as psychobiography (the study of the lives and personalities of public figures), psycholinguistics (the study of language and thinking), and psychoceramics (the study of crackpots).[1]



Dean Hanson/Albuquerque Journal/ZUMA Wire/Alamy Stock Photo

Psychology in court *Forensic psychologists* apply psychology's principles and methods in the criminal justice system. They may assess witness credibility or testify in court about a defendant's state of mind and future risk. This forensic psychologist testified that the defendant, who at age 15 showed no remorse after killing his parents and three younger siblings, has a *personality disorder.*

ASK YOURSELF

When you signed up for this course, what did you know about different psychology specialties?

Psychology also influences culture. Knowledge transforms us. Learning about the solar system and the germ theory of disease alters the way people think and act. Learning about psychology's findings also changes people: They less often judge psychological disorders as moral failings, treatable by punishment and ostracism. They less often

LAURENT/GLUCK/AGE Fotostock

Hope College Public Relations

Scott J. Ferrell/Getty Images

Psychology: A science and a profession Psychologists experiment with, observe, test, and help modify behavior. Here we see psychologists testing a child, measuring emotion-related physiology, and doing face-to-face therapy.

[1]Confession: I [DM] wrote the last part of this sentence on April Fool's Day.

"The mind, once stretched by a new idea, never returns to its original dimensions." — Ralph Waldo Emerson, 1803–1882

"I have uttered what I did not understand, things too wonderful for me." — Job 42:3

regard and treat women as men's mental inferiors. They less often view and raise children as ignorant, willful beasts in need of taming. "In each case," noted Morton Hunt (1990, p. 206), "knowledge has modified attitudes, and, through them, behavior." Once aware of psychology's well-researched ideas—about how body and mind connect, how a child's mind grows, how we construct our perceptions, how we learn and remember, how people across the world are alike (and different)—your mind may never again be the same.

But bear in mind psychology's limits. Don't expect it to answer the ultimate questions, such as those posed by Russian novelist Leo Tolstoy (1904): "Why should I live? Why should I do anything? Is there in life any purpose which the inevitable death that awaits me does not undo and destroy?"

Although many of life's significant questions are beyond psychology, some very important ones are illuminated by even a first psychology course. Through painstaking research, psychologists have gained insights into brain and mind, dreams and memories, depression and joy. Even the unanswered questions can renew our sense of mystery about things we do not yet understand. Moreover, your study of psychology can help teach you how to ask and answer important questions—how to think critically as you evaluate competing ideas and claims.

Psychology deepens our appreciation for how we humans perceive, think, feel, and act. By so doing, it can enrich our lives and enlarge our vision. Through this book we hope to help guide you toward that end. As activist and Nobel Peace Prize winner Malala Yousafzai said, "One teacher, one book, one pen can change the world."

RETRIEVAL PRACTICE

RP-11 Match the specialty (i through iii) with the description (a through c).

i. Clinical psychology	a. works to create social and physical environments that are healthy for all
ii. Psychiatry	b. studies, assesses, and treats people with psychological disorders but usually does not provide medical therapy
iii. Community psychology	c. is a branch of medicine dealing with psychological disorders

ANSWERS IN APPENDIX E

Use Psychology to Become a Stronger Person—and a Better Student

LOQ 1-9 How can psychological principles help you learn, remember, and thrive?

Psychology is not just about understanding others; it is also about understanding ourselves. It is only through such learning that we can be—and show to the world—our best selves. Throughout this text, we will offer evidence-based suggestions that you can use to live a happy, effective, flourishing life, including the following:

- ***Manage your time to get a full night's sleep.*** Unlike sleep-deprived people, who live with fatigue and gloomy moods, well-rested people live with greater energy, happiness, and productivity.
- ***Make space for exercise.*** Aerobic activity not only increases health and energy, it also is an effective remedy for mild to moderate depression and anxiety.
- ***Set long-term goals, with daily aims.*** Successful people take time each day to work toward their goals, such as exercising or sleeping more, or eating more healthfully. Over time, they often find that their daily practice becomes a habit.

- ***Have a growth mindset.*** Rather than seeing their abilities as fixed, successful people view their mental abilities as like a muscle—something that grows stronger with effortful use.
- ***Prioritize relationships.*** We humans are social animals. We flourish when connected in close relationships. We are both happier and healthier when supported by (and when supporting) caring friends.

Psychology's research also shows how we can learn and retain information. Many students assume that the way to cement new learning is to reread. What helps more—and what this book therefore encourages—is *repeated self-testing and rehearsal* of previously studied material. Memory researchers Henry Roediger and Jeffrey Karpicke (2006) call this phenomenon the **testing effect**. (It is also sometimes called the *retrieval practice effect* or *test-enhanced learning*.) They note that "testing is a powerful means of improving learning, not just assessing it." In one study, English-speaking students who had been tested repeatedly recalled the meaning of 20 previously learned Lithuanian words better than did students who had spent the same time restudying the words (Ariel & Karpicke, 2018). Repetitive testing's rewards also make it reinforcing: Students who used repetitive testing once found that it helped, and then used it later when learning new material.

"If you read a piece of text through twenty times, you will not learn it by heart so easily as if you read it ten times while attempting to recite it from time to time and consulting the text when your memory fails." — Francis Bacon, *Novum Organum*, 1620

Many other studies, including in college classrooms, confirm that *frequent quizzing and self-testing boosts students' retention* (Yang et al., 2021).

As explained in the Memory modules, to thoroughly understand information you must *actively process it*. One digest of 225 studies showed that students engaged in active learning showed the highest examination performance in science, technology, engineering, and mathematics (the STEM fields) (Freeman et al., 2014). Active learning is particularly useful at reducing achievement gaps between underrepresented (low income, marginalized culture) and overrepresented (high income, dominant culture) STEM students (Theobald et al., 2020). So, don't treat your mind like your stomach, something to be filled passively. Instead, treat it more like a muscle that grows stronger with exercise. Countless experiments reveal that people learn and remember best when they put material in their own words, rehearse it, and then retrieve and review it again.

The **SQ3R** study method incorporates these principles (McDaniel et al., 2009; Robinson, 1970). *SQ3R* is an acronym for its five steps: Survey, Question, Read, Retrieve[2], Review.

To study a module, first *survey*, taking a bird's-eye view. Scan each module's headings, and notice the organization.

Before you read each main section, try to answer its numbered Learning Objective *Question* (for this section: "How can psychological principles help you learn, remember, and thrive?"). Researchers have found that we retain information better after generating our own questions (Ebersbach et al., 2020; Roediger & Finn, 2010). Those who test their understanding *before* reading, and discover what they don't yet know, will learn and remember better.

Then *read*, actively searching for the answer to the Learning Objective Question (LOQ). At each sitting, read only as much of the module (usually a single main section) as you can absorb without tiring. Read actively and critically. Ask questions. Take notes. Make the ideas your own: How does what you've read relate to your own life? Does it support or challenge your assumptions? How convincing is the evidence? (Our Ask Yourself questions throughout each module will help you engage personally with the material.) Write out what you know. "Writing is often a tool for learning," say researchers (Arnold et al., 2017).

Having read a section, *retrieve* its main ideas: "Active retrieval promotes meaningful learning," says Karpicke (2012). So *test yourself*. This will not only help you figure out what you know, the testing itself will help you learn and retain the information more effectively. Even better, test yourself repeatedly. To facilitate this, we offer periodic *Retrieval Practice* questions throughout each module (for example, the questions at the end of this section). After answering these questions for yourself, you can "show" the answer to check your understanding (or check the answers in Appendix E) and reread the material as needed.

testing effect enhanced memory after retrieving, rather than simply rereading, information. Also referred to as a *retrieval practice effect* or *test-enhanced learning*.

SQ3R a study method incorporating five steps: *S*urvey, *Q*uestion, *R*ead, *R*etrieve, *R*eview.

[2]Also sometimes called "*R*ecite."

Finally, *review:* Read over any notes you have taken, again with an eye on the module's organization, and quickly review the whole module. Write or say what a concept is before rereading to check your understanding. The end-of-module *Review* is set up as an additional self-test, with the collected Learning Objective Questions, key terms, and Module Test questions.

Survey, question, read, retrieve, review. Four additional study tips may further boost your learning:

Distribute your study time. One of psychology's oldest findings is that *spaced practice* promotes better retention than *massed practice*. You'll remember material better if you space your time over several study periods—perhaps 1 hour a day, 6 days a week—rather than cram it into one week-long or all-night study blitz. For example, rather than trying to read an entire module in a single sitting, read just one main section and then turn to something else. *Interleaving* (mixing) your study of psychology with your study of other subjects boosts long-term retention and protects against overconfidence (Kornell & Bjork, 2008; Taylor & Rohrer, 2010).

Spacing your study sessions requires a disciplined approach to managing your time. For more tips on time management, see the Student Preface—Student Success: How to Apply Psychology to Live Your Best Life—at the beginning of this text.

Learn to think critically. Both inside and outside of this course, critical thinking—smart thinking—is a key to wisdom. Whether you are reading or conversing, note people's assumptions and values. What perspective or bias underlies an argument? Evaluate evidence. Is it anecdotal? Or is it based on informative experiments? Assess conclusions. Are there alternative explanations?

Process class information actively. Listen for the main ideas and sub-ideas of a lecture. *Write them down.* Ask questions during and after class. In class, as in your private study, process the information actively and you will understand and retain it better. As psychologist William James urged a century ago, "No reception without reaction, no impression without ... expression." Make the information your own. Engage with the Ask Yourself questions to relate what you read to your own life. Tell someone else about it. (As any teacher will confirm, to teach is to remember.)

Also, take notes *by hand.* Handwritten notes, in your own words, typically engage more active processing, with better retention, than does verbatim note taking on laptops (Mueller & Oppenheimer, 2014).

Overlearn. Psychology tells us that overlearning improves retention. We tend to overestimate how much we know. You may understand a module as you read it, but that feeling of familiarity can be deceptively comforting. By using all of the self-testing opportunities in the text and in Achieve, you can test your knowledge and *overlearn* in the process.

Memory experts Elizabeth Bjork and Robert Bjork (2011) offer simple, scientifically supported advice for how to improve your retention and your grades:

> Spend less time on the input side and more time on the output side, such as summarizing what you have read from memory or getting together with friends and asking each other questions. Any activities that involve testing yourself—that is, activities that require you to retrieve or generate information, rather than just representing information to yourself—will make your learning both more durable and flexible. (p. 63)

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More learning tips To learn more about the testing effect and the SQ3R method, watch this ***Video: Make Things Memorable*** at tinyurl.com/HowToRemember.

ASK YOURSELF

Of all of these helpful principles, which ones seem most relevant and important for improving your own life and studies? How will you add them to your usual routines?

RETRIEVAL PRACTICE

RP-12 The _____ _____ describes the enhanced memory that results from repeated retrieval (as in self-testing) rather than from simple rereading of new information.

RP-13 What does the acronym *SQ3R* stand for?

ANSWERS IN APPENDIX E

MODULE 1

REVIEW The History and Scope of Psychology

LEARNING OBJECTIVES

Test Yourself Answer these repeated Learning Objective Questions on your own (before "showing" the answers here, or checking the answers in Appendix D) to improve your retention of the concepts (McDaniel et al., 2009, 2015).

LOQ 1-1 How is psychology a science?

LOQ 1-2 What are the three key elements of the scientific attitude, and how do they support scientific inquiry?

LOQ 1-3 How does critical thinking feed a scientific attitude, and smarter thinking for everyday life?

LOQ 1-4 What were some important milestones in psychology's early history?

LOQ 1-5 How did behaviorism, Freudian psychology, and humanistic psychology further the development of psychological science?

LOQ 1-6 How has contemporary psychology focused on cognition, on biology and experience, on culture and gender, and on human flourishing?

LOQ 1-7 How do psychologists use the biopsychosocial approach, and how can it help us understand our diverse world?

LOQ 1-8 What are psychology's main subfields?

LOQ 1-9 How can psychological principles help you learn, remember, and thrive?

TERMS AND CONCEPTS TO REMEMBER

Test Yourself Write down the definition in your own words, then check your answer.

empirical approach, p. 2
critical thinking, p. 3
structuralism, p. 6
functionalism, p. 6
behaviorism, p. 8
humanistic psychology, p. 9
cognitive psychology, p. 9
cognitive neuroscience, p. 9
psychology, p. 9
nature–nurture issue, p. 10
natural selection, p. 10
evolutionary psychology, p. 10
behavior genetics, p. 10
culture, p. 11
positive psychology, p. 12
biopsychosocial approach, p. 12
levels of analysis, p. 12
basic research, p. 14
applied research, p. 14
counseling psychology, p. 14
clinical psychology, p. 14
psychiatry, p. 14
community psychology, p. 14
testing effect, p. 17
SQ3R, p. 17

MODULE TEST

Test Yourself Answer the following questions on your own first, then "show" the answers here, or check your answers in Appendix E.

1. How can critical thinking help you evaluate claims in the media, even if you're not a scientific expert on the issue?

2. In 1879, in psychology's first experiment, _____ _____ and his students measured the time lag between hearing a ball hit a platform and pressing a key.

3. William James would be considered a(n) _____. Wilhelm Wundt and Edward Titchener would be considered _____.
   a. functionalist; structuralists
   b. structuralist; functionalists
   c. evolutionary theorist; structuralists
   d. functionalist; evolutionary theorists

4. In the early twentieth century, _____ redefined psychology as "the science of observable behavior."
   a. John B. Watson
   b. Abraham Maslow
   c. William James
   d. Sigmund Freud

5. Nature is to nurture as
   a. personality is to intelligence.
   b. biology is to experience.
   c. intelligence is to biology.
   d. psychological traits are to behaviors.

6. "Nurture works on what nature provides." Describe what this means, using your own words.

7. Which of the following is true regarding gender differences and similarities?
   a. Gender differences outweigh any similarities.
   b. Despite some gender differences, the underlying processes of human behavior are the same.
   c. Gender similarities and differences both depend more on biology than on environment.
   d. Gender differences are so numerous that it is difficult to make meaningful comparisons.

8. Martin Seligman and other researchers who explore various aspects of human flourishing refer to their field of study as _____ _____.

9. A psychologist treating emotionally troubled adolescents at a local mental health agency is most likely to be a(n)
   a. research psychologist.
   b. psychiatrist.
   c. industrial-organizational psychologist.
   d. clinical psychologist.

10. A mental health professional with a medical degree who can prescribe medication is a _____.

11. A psychologist conducting basic research to expand psychology's knowledge base may
   a. design a computer screen with limited glare and assess the effect on computer operators' eyes after a day's work.
   b. treat older people who experience depression.
   c. observe 3- and 6-year-olds solving puzzles and analyze differences in their abilities.
   d. interview children with behavioral problems and suggest treatments.

MODULE

2 Research Strategies: How Psychologists Ask and Answer Questions

Hoping to satisfy their curiosity about people and to relieve their own woes, millions turn to "psychology." They read advice columns aimed at helping people cope with their problems, overcome their addictions, and save their marriages. They watch "celebrity psychics" demonstrate their supposed powers. They attend stop-smoking hypnosis seminars. They play online games, hoping to strengthen their brain. They immerse themselves in self-help books, websites, and lectures that promise to teach the path to love, the road to personal happiness, and the "hacks," or shortcuts, to success.

Others, intrigued by claims of psychological truth, wonder: How—and how much—does parenting shape children's personalities and abilities? Are first-born children more driven to achieve? Do dreams have deep meaning? Do we sometimes remember events that never happened? Does psychotherapy heal?

In working with such questions, the science of psychology does more than speculate. To separate uninformed opinions from examined conclusions, psychologists use the *scientific method* to conduct research. Let's consider how psychology's researchers do their science.

The Need for Psychological Science

LOQ 2-1 How does our everyday thinking sometimes lead us to a wrong conclusion?

Some people suppose that psychology is mere common sense—documenting and dressing in jargon what people already know: "You get paid for using fancy methods to tell me what everyone knows?"

Indeed, our intuition is often right. As the baseball great Yogi Berra (1925–2015) once said, "You can observe a lot by watching." (We also have Berra to thank for other gems, such as "Nobody goes there anymore—it's too crowded," and "If the people don't want to come out to the ballpark, nobody's gonna stop 'em.") Because we're all behavior watchers, it would be surprising if many of psychology's findings had *not* been foreseen. Many people believe that love breeds happiness, for example, and they are right (we have what researchers call a deep "need to belong").

But sometimes what seems like common sense, informed by countless casual observations, is wrong. In other modules, we will see how research has overturned popular

ideas—that familiarity breeds contempt, that dreams predict the future, and that most of us use only 10 percent of our brain. We will also see how research has surprised us with discoveries about how the brain's chemical messengers control our moods and memories, about other animals' abilities, and about the relationship between social media use and depression.

Other things seem like commonsense truth only because we so often hear them repeated. Mere repetition of statements—whether true or false—makes them easier to process and remember, and thus more true-seeming (Dechêne et al., 2010; Fazio et al., 2015). Easy-to-remember misconceptions ("Bundle up before you go outside, or you will catch a cold!") can therefore overwhelm hard truths. This power of familiar, hard-to-erase falsehoods is a lesson well known to political manipulators and kept in mind by critical thinkers.

Three common flaws in commonsense thinking—*hindsight bias, overconfidence,* and *perceiving order in random events*—illustrate how, as novelist Madeleine L'Engle (1973) observed, "The naked intellect is an extraordinarily inaccurate instrument."

hindsight bias the tendency to believe, after learning an outcome, that one would have foreseen it. (Also known as the *I-knew-it-all-along phenomenon.*)

Did We Know It All Along? Hindsight Bias

Consider how easy it is to draw the bull's-eye *after* the arrow strikes. After the stock market drops, people say it was "due for a correction." After an athletic match, we credit the coach if a "gutsy play" wins the game and criticize the same "stupid play" if it doesn't. After a war or an election, its outcome usually seems obvious. Although history may therefore seem like a series of inevitable events, the actual future is seldom foreseen. No one's diary recorded, "Today the Hundred Years' War began."

This **hindsight bias** is easy to demonstrate by giving half the members of a group some purported psychological finding and giving the other half an opposite result. Tell the first group, for example: "Psychologists have found that separation weakens romantic attraction. As the saying goes, 'Out of sight, out of mind.'" Ask them to imagine why this might be true. Most people can, and after hearing an explanation, nearly all will then view this true finding as unsurprising.

Tell the second group the opposite: "Psychologists have found that separation strengthens romantic attraction. As the saying goes, 'Absence makes the heart grow fonder.'" People given this untrue result can also easily imagine it, and most will also see it as unsurprising. When opposite findings both seem like common sense, there is a problem.

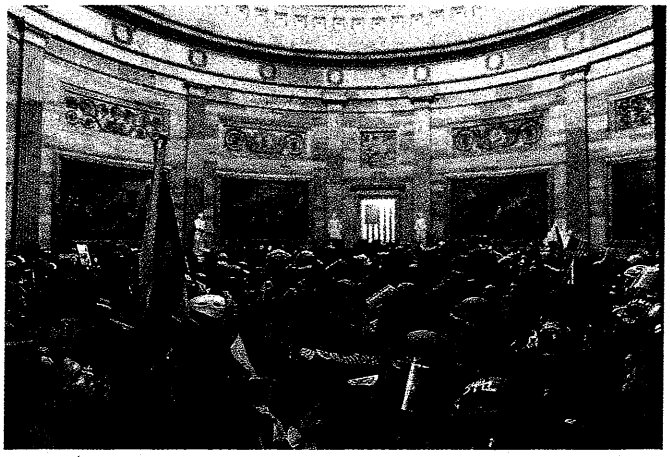
Such errors in people's recollections and explanations show why we need psychological research. It's not that common sense is usually wrong. Rather, common sense describes, after the fact, what *has* happened better than it predicts what *will* happen.

More than 800 scholarly papers have shown hindsight bias in people young and old from around the world (Roese & Vohs, 2012). As physicist Niels Bohr reportedly jested, "Prediction is very difficult, especially if it's about the future."

"In life as in history the unexpected lies waiting, grinning from around corners. Only with hindsight are we wise about cause and effect." — Author Penelope Lively, *Moon Tiger*

Hindsight bias As the Covid-19 pandemic began spreading in early 2020, some countries' leaders told their people not to panic over "a measly cold," assured their people that the virus was "very well under control," and encouraged people to continue to "live life as usual." In hindsight, such misjudgments cost many lives. Likewise, after the 2021 mob assault on the U.S. Capitol, it was, in hindsight, obvious that security officials should have anticipated the attack.

John Moore/Getty Images



Mostafa Bassim/Anadolu Agency/Getty Images

Overconfidence

We humans tend to think we know more than we do. Asked how sure we are of our answers to factual questions *(Is Boston north or south of Paris?)*, we tend to be more confident than correct.[3] And our confidence often drives us to quick—rather than correct—thinking (Rahnev et al., 2020). Consider these three anagrams, shown beside their solutions (from Goranson, 1978):

Fun anagram solutions from Wordsmith (wordsmith.org):
Snooze alarms = Alas! No more z's
Dormitory = dirty room
Slot machines = cash lost in 'em

WREAT → WATER

ETRYN → ENTRY

GRABE → BARGE

About how many seconds do you think it would have taken you to unscramble each of these? Did hindsight influence you? Knowing the answers tends to make us overconfident. (Surely, the solution would take only 10 seconds or so?) In reality, the average problem solver spends 3 minutes, as you also might, given a similar anagram without the solution: OCHSA.[4]

Are we any better at predicting social behavior? Psychologist Philip Tetlock (1998, 2005) collected more than 27,000 expert predictions of world events, such as whether Quebec would separate from Canada. His repeated finding: These predictions, which experts made with 80 percent confidence on average, were right less than 40 percent of the time.

Overconfidence in history:

"Not within a thousand years will man ever fly." — Wilbur Wright, in 1901, 2 years before he and his brother, Orville, made the first powered flight

"Computers in the future may weigh no more than 1.5 tons." — *Popular Mechanics*, 1949

"They couldn't hit an elephant at this distance." — General John Sedgwick just before being killed during a U.S. Civil War battle, 1864

"No woman in my time will be prime minister." — Margaret Thatcher, 1969 (British Prime Minister, 1979–1990)

ASK YOURSELF

Do you have a hard time believing you may be overconfident? Could overconfidence be at work in that self-assessment? How might reading this section about overconfidence help reduce your tendency to be overconfident?

RETRIEVAL PRACTICE

RP-1 Why, after friends start dating, do we often feel that we *knew* they were meant to be together?

ANSWERS IN APPENDIX E

Perceiving Order in Random Events

We're born with an eagerness to make sense of our world. People see a face on the Moon, hear Satanic messages in music, or perceive the Virgin Mary's image on a grilled cheese sandwich. Even in random data, we often find patterns, because—here's a curious fact of life—*random sequences often don't look random* (Falk et al., 2009; Nickerson, 2002, 2005). Flip a coin 50 times and you may be surprised at the streaks of heads and tails—much like supposed "hot" and "cold" streaks in basketball shooting and baseball hitting. In actual random sequences, patterns and streaks (such as repeating digits) occur more often than people expect (Oskarsson et al., 2009). That also makes it hard for people to generate random-like sequences. When embezzlers try to simulate random digits when specifying how much to steal, their nonrandom patterns can alert fraud experts (Poundstone, 2014).

Why are we so prone to pattern-seeking? For most people, a random, unpredictable world is unsettling (Tullett et al., 2015). Making sense of our world relieves stress and helps us get on with daily living (Ma et al., 2017).

Some happenings, such as winning a lottery twice, seem so extraordinary that we find it difficult to conceive an ordinary, chance-related explanation. "But with a large enough sample," say statisticians, "any outrageous thing is likely to happen" (Diaconis & Mosteller, 1989). An event that happens to but 1 in 1 billion people every day occurs about 7 times a day, more than 2500 times a year.

"The really unusual day would be one where nothing unusual happens." — Statistician Persi Diaconis (2002)

[3]Boston is south of Paris.

[4]The anagram solution: CHAOS.

The point to remember: Our commonsense thinking is flawed due to three powerful tendencies: hindsight bias, overconfidence, and our tendency to perceive patterns in random events. But scientific inquiry can help us sift reality from illusion.

Psychological Science in a Post-Truth World

LOQ 2-2 Why are we so vulnerable to believing untruths?

In 2017, the Oxford English Dictionary's word of the year was *post-truth*—describing a modern culture where people's emotions and personal beliefs often override their acceptance of objective facts.

Consider three examples of such "truth decay" (widely shared misinformation):

Belief: *The U.S. crime rate is rising.* Nearly every year since 1993, most U.S. adults have told Gallup that there is more crime "than there was a year ago" (Gallup, 2021).

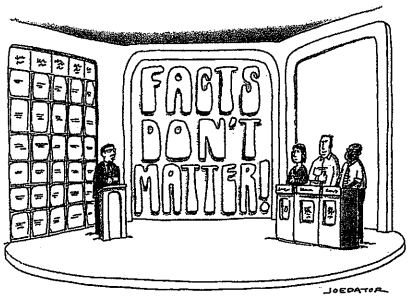
Fact: For several decades, both violent and property crime rates have been *falling.* Between 1993 and 2019, the U.S. violent crime rate dropped 49 percent (Gramlich, 2020).

Belief: *Crime is common among immigrants* (McCarthy, 2017). Memorable incidents feed this narrative. Stories of an immigrant murdering, burglarizing, or lying spread through social networks and news outlets. Such fears are commonplace not only in North America, but also in Europe and Australia (Esses, 2021).

Fact: Most immigrants are *not* criminals. Compared with native-born Americans, immigrants are 44 percent *less* likely to be imprisoned (CATO, 2017; Flagg, 2018, 2019). The same has been true in Italy, the United Kingdom, and elsewhere (Di Carlo et al., 2018).

Belief: *Many people have died soon after receiving a Covid-19 vaccine.*

Fact: This statement is true, but not meaningful. With millions of people dying each year, some of those inevitably will die after receiving a vaccine, even though the vaccine itself (as of mid-2021) had caused no deaths (Rizzo, 2021).



Joe Dator/Cartoon Stock

"I'm sorry, Jeannie, your answer was correct, but Kevin shouted his incorrect answer over yours, so he gets the points."

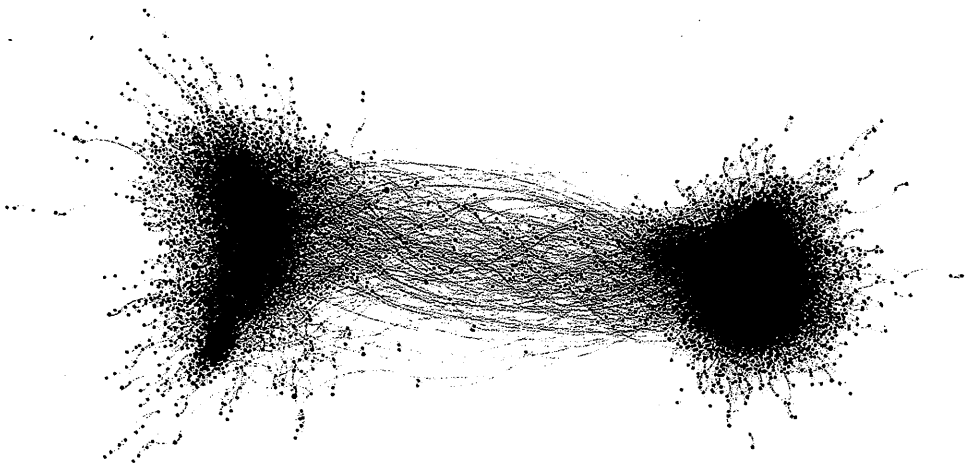
In the United States, political party bias has distorted people's thinking. Extremely liberal and extremely conservative Americans both, with similar self-confidence, view their beliefs as superior (Harris & Van Bavel, 2021). Among single-and-looking U.S. Democrats, 71 percent said that they would not date someone who voted for Donald Trump, while 47 percent of Republicans would not date someone who voted for Hillary Clinton (Pew, 2020). When rating candidates for college scholarships, both Democrats and Republicans discriminate against those from the other party (Iyengar & Westwood, 2015). Extremely liberal people and extremely conservative people also show an equally rigid mindset and use the same amount of negative and angry language—they only differ in the issues they support (Frimer et al., 2019; Zmigrod et al., 2020). So, no American can smugly think "Yes, but bias doesn't apply to *me*." Bias goes both ways.

U.S. Democrats and Republicans share concerns about failures to separate fact from fiction. In 2021, President Joe Biden (2021) warned that favoring one's political beliefs rather than scientific research "undermines the welfare of the Nation, contributes to systemic inequities and injustices, and violates the trust that the public places in government to best serve its collective interests." Republican Senator Mitt Romney (2021) similarly expressed concern about false news, urging politicians to show people respect "by telling them the truth." Any agreement across partisan divides requires first a shared understanding of the essential facts.

So why do post-truth-era people so often, in the words of psychologist Tom Gilovich (1991), "know what isn't so?"

False news Some misinformation gets fed to us intentionally. It's "lies in the guise of news" (Kristof, 2017). In the 2016 U.S. election cycle, 6 percent of all Twitter-enabled news consumption was false news (Grinberg et al., 2019). In the United States and United Kingdom, exposure to false news related to Covid-19 vaccines was dangerous, reducing people's intention to accept a Covid vaccine (Loomba et al., 2021). And

FIGURE 2.1
The meeting of like minds On social media, most people discuss contentious issues with like-minded others. In this graph of politically charged Twitter activity, each node represents a user who sent a message; each line represents a user who retweeted something. As we can see, users overwhelmingly sent messages to, and retweeted messages from, those who shared their liberal (blue) or conservative (red) ideology (Brady et al., 2017).



Moral contagion in social networks William J. Brady, Julian A. Wills, John T. Jost, Joshua A. Tucker, Jay J. Van Bavel *Proceedings of the National Academy of Sciences* Jul 2017, *114*(28) 7313-7318; DOI:10.1073/pnas.1618923114

Marty Bucella/Cartoon Stock

"The best way we can transcend ideology is to teach our students, regardless of their majors, to think like scientists."
— Psychologist (and Yale University President) Peter Salovey, "Knowledge Can Be Power," 2018

"We have ... become sloppier than ever: Tweet first, research later. Post first, rescind later. Guess first, confirm later." — Luvvie Ajayi, *I'm Judging You: The Do-Better Manual*, 2016

made-up news is catchy. In one analysis of 126,000 stories tweeted by 3 million people, falsehoods—especially false political news—"diffused significantly farther, faster, deeper, and more broadly than the truth" (Vosoughi et al., 2018). Amid this sea of misinformation, we should remember Britain's scientific academy, the British Royal Society's, motto: *nullius in verba* (take nobody's word for it). The good news is that most people can tell the difference between high-quality and low-quality information sources (Pennycook & Rand, 2019). When encouraged to use slow, deliberate thinking rather than to go with their gut, people better discern fiction from fact (Bago et al., 2020).

Repetition In experiments, statements become more believable when they are repeated (De keersmaecker et al., 2020). From childhood onward, what we hear over and over—perhaps a made-up smear of a political opponent—becomes familiar, gets remembered, and comes to seem true and worth sharing (Effron & Raj, 2020; Fazio & Sherry, 2020).

Availability of powerful examples In the media, "if it bleeds it leads." Gruesome violence—a horrific murder, a mass killing, a plane crash—gets reported, with vivid images that color our judgments. No wonder Americans grossly overestimate their risk of being victimized by crime, terror, and plane crashes.

Group identity and the echo chamber of the like-minded Our social identities matter. Feeling good about our groups helps us feel good about ourselves. On social media we tend to friend and follow people who think as we do (Cinelli et al., 2021; see **FIGURE 2.1**). We often prefer news sources that affirm our views and demonize news sources that do not. And we often live among like-minded neighbors (Brown & Enos, 2021).

The good news is that we can build a real-truth world by embracing a scientific mindset. Mindful of our own biases, we can listen and learn. Confronted with an opposing view, we can discuss before we dismiss. And with a mix of curiosity, skepticism, and humility, we can adopt the spirit of critical thinking: *To accept everything is to be gullible; to deny everything is to be a cynic.*

The Scientific Method

The foundation of all science is a scientific attitude that combines *curiosity*, *skepticism*, and *humility*. Psychologists arm their scientific attitude with the *scientific method*—a self-correcting process for evaluating ideas with observation and analysis. Psychological science welcomes hunches and plausible-sounding theories. And it puts them to the test. If a theory works—if the data support its predictions—so much the better for that theory. If the predictions fail, the theory gets revised or rejected. When researchers submit their work to a scientific journal, **peer reviewers**—other scientists who are

peer reviewers scientific experts who evaluate a research article's theory, originality, and accuracy.

experts—evaluate a study's theory, originality, and accuracy. The journal editor then uses the peer reviews to decide whether the research deserves publication.

theory an explanation using an integrated set of principles that organizes observations and predicts behaviors or events.

hypothesis a testable prediction, often implied by a theory.

Constructing Theories

LOQ 2-3 How do theories advance psychological science?

In everyday conversation, we often use *theory* to mean "mere hunch." Someone might, for example, discount evolution as "only a theory"—as if it were mere speculation. In science, a **theory** explains behaviors or events by offering ideas that organize observations. By using deeper principles to organize isolated facts, a theory summarizes and simplifies. As we connect the observed dots, a coherent picture emerges.

A theory of how sleep affects memory, for example, helps us organize countless sleep-related observations into a short list of principles. Imagine that we observe over and over that people with good sleep habits tend to answer questions correctly in class and do well at test time. We might therefore theorize that sleep improves memory. So far, so good: Our principle neatly summarizes a list of observations about the effects of a good night's sleep.

Yet no matter how reasonable a theory may sound—and it does seem reasonable to suggest that sleep boosts memory—we must put it to the test. A good theory produces testable *predictions,* called **hypotheses.** Such predictions specify which results would support the theory and which results would disconfirm it. To test our theory about sleep effects on memory, we might hypothesize that when sleep deprived, people will remember less from the day before. To test that hypothesis, we might assess how well people remember course materials they studied either before a good night's sleep or before a shortened night's sleep (**FIGURE 2.2**). The results will either support our theory or lead us to revise or reject it.

Our theories can bias our observations. Having theorized that better memory springs from more sleep, we may see what we expect: We may perceive sleep-deprived people's answers as less accurate. The urge to see what we expect is strong, both inside and outside the laboratory, as when people's views of climate change influence their interpretation of local weather events.

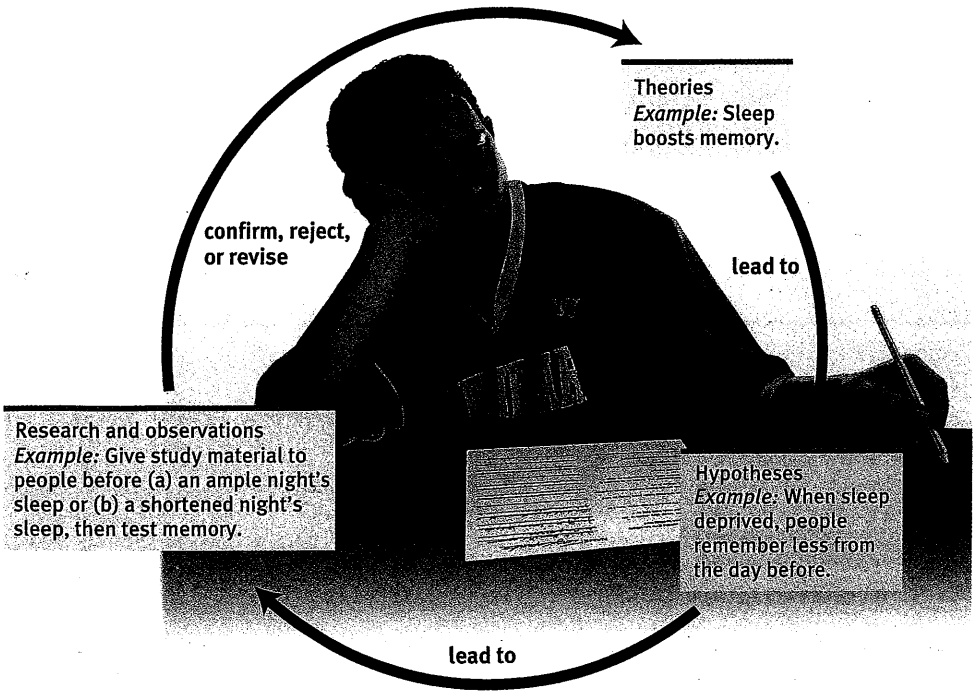


FIGURE 2.2
The scientific method This self-correcting process asks questions and observes answers.

In the end, our theory will be useful if it (1) *organizes* observations and (2) implies *predictions* that anyone can use to check the theory or to derive practical applications. (Does people's sleep predict their retention?) Eventually, our research may (3) stimulate further research that leads to a revised theory that better organizes and predicts.

As a check on their own biases, psychologists report their research with precise, measurable **operational definitions** of research procedures and concepts. *Sleep deprived,* for example, may be defined as "at least 2 hours less" than the person's natural sleep. (Likewise, a study of "aggression" may observe how many pins you stab into a doll that represents a lab partner, or a study of "helping" may record dollars donated.) By using carefully worded statements, others can **replicate** (repeat) the original observations with different participants, materials, and circumstances. If they get similar results, confidence in the finding's reliability grows. The first study of hindsight bias, for example, aroused psychologists' curiosity. Now, after many successful replications with differing people and questions, we feel sure of the phenomenon's power. Replication is confirmation.

"Failure to replicate is not a bug; it is a feature. It is what leads us along the path—the wonderfully twisty path—of scientific discovery." — Lisa Feldman Barrett, "Psychology Is Not in Crisis," 2015

Replication is an essential part of good science. Over the span of a decade, psychologists attempted to replicate 307 studies. They were able to reproduce similar results 64 percent of the time (Nosek et al., 2022). Replication failures often occur when samples are small, so psychologists increasingly study large samples (Blake & Gangestad, 2020; Sassenberg & Ditrich, 2019). A bigger sample = a more replicable result.

Today's psychological research is benefiting from more replications, more rigorous research methods, and more sharing of research data and tips on how best to analyze it (Agrawal et al., 2020; Dougherty et al., 2018; Smaldino & McElreath, 2016). Professional societies and crowdsourced projects create communities of psychological scientists who work together to improve their research methods and practices (Landy et al., 2020). More and more psychologists also use **preregistration** to publicly communicate their planned study design, hypotheses, data collection, and analyses (Nosek et al., 2018). This openness and transparency also prevents later modifications, such as changing the hypotheses to fit the data. Rather than pressuring researchers to publish only the results that support their predictions, preregistration encourages psychologists to openly report all of their results—even when that means failing to replicate earlier findings (Kristal et al., 2020). There is still a place for *exploratory research:* Investigators gather data and seek patterns that inspire theories, which can then be tested with *confirmatory research* (with preregistered hypotheses and preplanned analyses).

Psychological science also harnesses the power of *meta-analysis* (a statistical procedure for analyzing the results of multiple studies to reach an overall conclusion). Researchers use this procedure to statistically summarize a body of scientific evidence. By combining the results of many studies, researchers avoid the problem of small samples and can get a broader understanding of what they are studying. Replications, collaborations, preregistrations, explorations, and meta-analyses are all enabling "Psychology's Renaissance" of improved scientific practices (Nelson et al., 2018).

As we will see next, we can test our hypotheses and refine our theories using *descriptive* methods (which describe behaviors, often through case studies, surveys, or naturalistic observations), *correlational* methods (which associate different variables), and *experimental* methods (which manipulate variables to discover their effects). To think critically about popular psychology claims, we need to understand these methods and know what conclusions they allow.

operational definition a carefully worded statement of the exact procedures (operations) used in a research study. For example, *human intelligence* may be operationally defined as what an intelligence test measures. (Also known as *operationalization.*)

replication repeating the essence of a research study, usually with different participants in different situations, to see whether the basic finding can be reproduced.

preregistration publicly communicating planned study design, hypotheses, data collection, and analyses.

RETRIEVAL PRACTICE

RP-2 What does a good theory do?

RP-3 Why is replication important?

ANSWERS IN APPENDIX E

Description

LOQ 2-4 How do psychologists use case studies, naturalistic observations, and surveys to observe and describe behavior, and why is random sampling important?

The starting point of any science is description. In everyday life, we all observe and describe people, often drawing conclusions about why they think, feel, and act as they do. Psychologists do much the same, though more objectively and systematically, through

- ***case studies*** (in-depth analyses of individuals or groups),
- ***naturalistic observations*** (recording the natural behavior of many individuals), and
- ***surveys and interviews*** (asking people questions).

THE CASE STUDY Among the oldest research methods, the **case study** examines one individual or group in depth in the hope of revealing things true of us all. Some examples:

- ***Brain damage.*** Much of our early knowledge about the brain came from case studies of individuals who suffered particular impairments after damage to a certain brain region.
- ***Children's minds.*** Pioneering developmental psychologist Jean Piaget taught us about children's thinking after carefully observing and questioning only a few children.
- ***Animal intelligence.*** Studies of various animals, including a few chimpanzees, have revealed their capacity for understanding and language.

Intensive case studies are sometimes very revealing, and they often suggest directions for further study. But atypical individual cases may mislead us. Both in our everyday lives and in science, unrepresentative information can lead to mistaken judgments and false conclusions. Indeed, anytime a researcher mentions a finding *(Smokers die younger: 95 percent of men over 85 are nonsmokers)* someone is sure to offer a contradictory anecdote *(Well, I have an uncle who smoked two packs a day and lived to be 89!)*.

Dramatic stories and personal experiences (even psychological case examples) command our attention and are easily remembered. Journalists understand that and often begin their articles with compelling stories. Stories move us, but stories can mislead. Which of the following do you find more memorable? (1) "In one study of 1300 dream reports concerning a kidnapped child, only 5 percent correctly envisioned the child as dead" (Murray & Wheeler, 1937). (2) "I know a man who dreamed his sister was in a car accident, and two days later she died in a head-on collision!" Numbers can be numbing, but *the plural of anecdote is not evidence.* A single story of someone who supposedly changed from gay to straight is not evidence that sexual orientation is a choice. As psychologist Gordon Allport (1954, p. 9) said, "Given a thimbleful of [dramatic] facts we rush to make generalizations as large as a tub."

The point to remember: Individual cases can suggest fruitful ideas. What's true of all of us can be glimpsed in any one of us. But to find those general truths, we must employ other research methods.

Skye Hohmann/Alamy Stock Photo

Freud and Little Hans Sigmund Freud's case study of 5-year-old Hans' extreme fear of horses led Freud to his theory of childhood sexuality. He conjectured that Hans felt unconscious desire for his mother, feared castration by his rival father, and then transferred this fear into his phobia about being bitten by a horse. Today's psychological science discounts Freud's theory of childhood sexuality but does agree that much of the human mind operates outside our conscious awareness. (More on this in the Personality modules.)

RETRIEVAL PRACTICE

RP-4 We cannot assume that case studies always reveal general principles that apply to all of us. Why not?

ANSWERS IN APPENDIX E

NATURALISTIC OBSERVATION A second descriptive method involves recording responses in natural environments. These **naturalistic observations** traditionally ranged from watching chimpanzee societies in the jungle, to videotaping and analyzing parent-child interactions in different cultures, to recording racial differences in students' self-seating patterns in a school lunchroom. Until recently, such naturalistic observation was mostly "small science"—possible to do with pen and paper rather than fancy

case study a descriptive technique in which one individual or group is studied in depth in the hope of revealing universal principles.

naturalistic observation a descriptive technique of observing and recording behavior in naturally occurring situations without changing or controlling the situation.

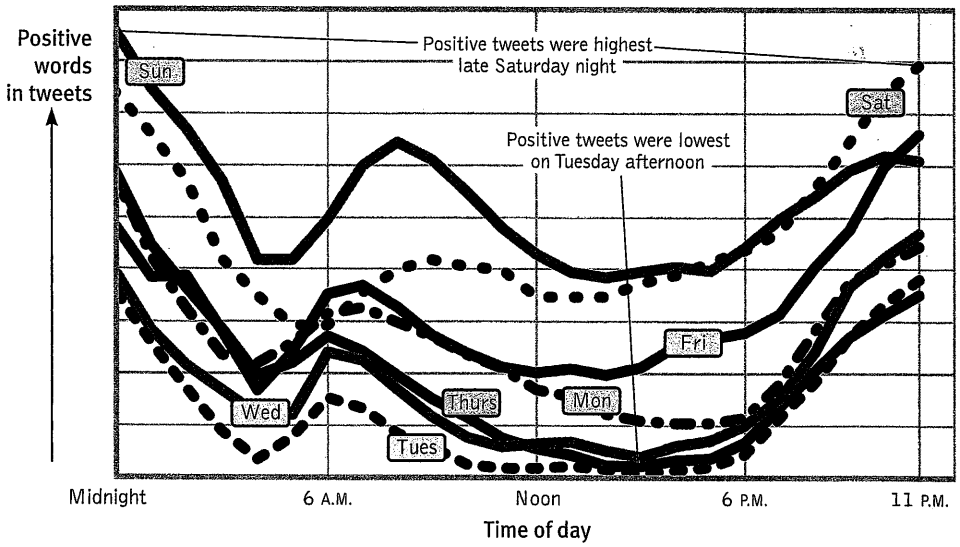
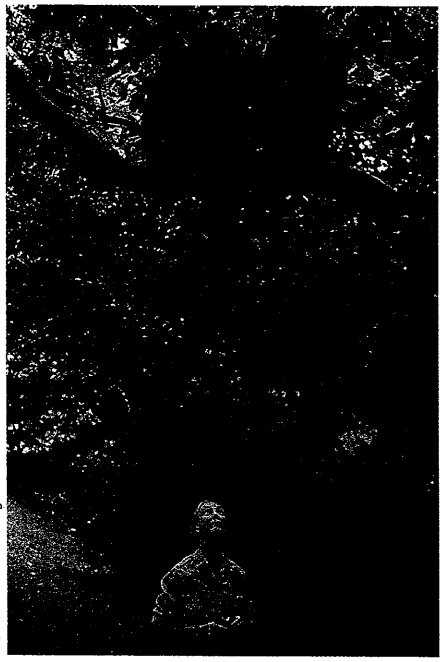


FIGURE 2.3
Twitter message moods, by time and by day This graph illustrates how researchers can use big data to study human behavior on a massive scale. It now is also possible to associate people's moods with, for example, their locations or with the weather, and to study the spread of ideas through social networks. (Data from Golder & Macy, 2011.)

A natural observer "Observations, made in the natural habitat," noted chimpanzee observer Jane Goodall (1998), "helped to show that the societies and behavior of animals are far more complex than previously supposed."



equipment and a big budget (Provine, 2012). But today's digital technologies—thanks to "big data" harvested from phone apps, social media, online searches, and more—have transformed naturalistic observations into big science. Anonymously tapping into 15 million cell phones' GPS allowed scientists to track how often people in different geological regions obeyed stay-at-home orders and social distancing recommendations during the Covid-19 pandemic (Glanz et al., 2020). New technologies—wearable cameras and fitness sensors, and internet-connected smart-home sensors—offer increasing possibilities for people to allow accurate recording of their activity, relationships, sleep, and stress (Nelson & Allen, 2018; Yokum et al., 2019).

The billions of people entering personal information online have also enabled big-data observations (without disclosing individual identities). One research team studied the ups and downs of human moods by counting positive and negative words in 504 million tweets from 84 countries (Golder & Macy, 2011). As **FIGURE 2.3** shows, people seemed happier on weekends, shortly after waking, and in the evenings. (Are late Saturday evenings often a happy time for you, too?) Another study found that negative emotion (especially anger-related) words in 148 million tweets from 1347 U.S. counties predicted the counties' heart disease rates *better* than smoking and obesity rates (Eichstaedt et al., 2015). Online searching enables people to learn about the world, and people's online searching enables researchers to learn about people. For example, the words people search and the questions they ask can gauge a region's level of racism and depression. But online searches also reveal our universal human likeness—as illustrated by the word *pregnant* being searched in conjunction with the same food cravings worldwide (Stephens-Davidowitz, 2017). Across the globe, we are kin beneath the skin.

Like the case study, naturalistic observation does not *explain* behavior. It *describes* it. Nevertheless, descriptions can be revealing. We once thought, for example, that only humans use tools. Then naturalistic observation revealed that chimpanzees sometimes insert a stick in a termite mound and withdraw it, eating the stick's load of termites. Such unobtrusive naturalistic observations paved the way for later studies of animal thinking, language, and emotion, which further expanded our understanding of our fellow animals. Thanks to researchers' observations, we know that chimpanzees and baboons use deception: Psychologists repeatedly saw one young baboon pretending to have been attacked by another as a tactic to get its mother to drive the other baboon away from its food (Whiten & Byrne, 1988).

Naturalistic observations also illuminate human behavior. Here are two findings you might enjoy:

- *A **funny finding.*** We humans laugh 30 times more often in social situations than in solitary situations (Provine, 2001). (Have you noticed how seldom you laugh when alone?)

- *Culture and the pace of life.* Naturalistic observation also enabled Robert Levine and Ara Norenzayan (1999) to compare the pace of life—walking speed, the accuracy of public clocks, and so forth—in 31 countries. Their conclusion: Life is fastest paced in Japan and Western Europe, and slower-paced in economically less-developed countries.

Naturalistic observation offers interesting snapshots of everyday life, but it does so without controlling for all the factors that may influence behavior. It's one thing to observe the pace of life in various places, but another to understand what makes some people walk faster than others. Nevertheless, descriptions can be revealing: The starting point of any science is description.

RETRIEVAL PRACTICE

RP-5 What are the advantages and disadvantages of naturalistic observation?

ANSWERS IN APPENDIX E

THE SURVEY A **survey** looks at many cases, asking people to report their behavior or opinions. Questions about everything from sexual practices to political opinions are put to the public. Here are some recent survey findings:

- Compared with young adults of an earlier generation (those born in the 1960s and 1970s), twice as many millennials born in the 1990s reported having no sexual partners since age 18 (Twenge, 2017). Today's less attached young adults are experiencing what one writer termed a "sex recession" (Julian, 2018).
- 1 in 2 people across 24 countries reported believing in the "existence of intelligent alien civilizations in the universe" (Lampert, 2017).
- 54 percent of all humans—some 4.1 billion people—say that religion is very important in their lives (Pew, 2019).

But asking questions is tricky. People may shade their answers in a socially desirable direction, such as by underreporting their cigarette consumption or overreporting their voting. And the answers often depend on how researchers' questions are worded and how respondents are chosen.

Wording Effects Even small changes in the order or wording of questions can make a big difference (**TABLE 2.1**). When U.S. White evangelical Christians were asked whether (1) "Humans have evolved over time" or (2) "Humans have existed in their present form since the beginning of time," only 32 percent expressed a belief in evolution (Funk, 2019). But when asked whether (1) "Humans have evolved over time due to processes such as natural selection; God or a higher power had no part in this process"; (2) "Humans have evolved over time due to processes that were guided or allowed by God or a higher power"; or (3) "Humans have existed in their present form since the beginning of time," more than twice as many—68 percent—expressed a belief in evolution. Because wording is such a delicate matter, critical thinkers will reflect on how the phrasing of a question might affect people's expressed opinions.

TABLE 2.1 Survey Wording Effects

Garners More Approval	Garners Less Approval
"aid to those in need"	"welfare"
"undocumented workers"	"illegal aliens"
"gun safety laws"	"gun control laws"
"revenue enhancers"	"taxes"
"enhanced interrogation"	"torture"

survey a descriptive technique for obtaining the self-reported attitudes or behaviors of a particular group, usually by questioning a representative, *random sample* of the group.

Random Sampling In everyday thinking, we tend to generalize from samples we observe, especially vivid cases. An administrator who reads (a) a statistical summary of an instructor's student evaluations and (b) the vivid comments of two irate students may be influenced as much by the biased sample of two unhappy students as by the many favorable evaluations in the statistical summary. The temptation to succumb to the *sampling bias*—to generalize from a few vivid but unrepresentative cases—is nearly irresistible.

So how do you obtain a *representative sample?* Say you want to learn how students at your college or university feel about online learning. It's often not possible to survey the whole group. How then could you choose a group that would represent the total student body? Typically, you would seek a **random sample**, in which every person in the entire **population** has an equal chance of being included in the sample group. You might number the names in the school's student roster and use a random-number generator to pick your survey participants. (Sending each student a questionnaire wouldn't work because the conscientious people who returned it would not be a random sample.) Large representative samples are better than small ones, but a smaller representative sample of 100 is better than a larger unrepresentative sample of 500. You cannot compensate for an unrepresentative sample by simply adding more people.

Political pollsters sample voters in national election surveys just this way. Without random sampling, large samples—such as from "opt-in" website polls—often give misleading results. But by using some 1500 randomly sampled people, drawn from all areas of a country, polls can provide a reasonably accurate snapshot of the nation's opinions. In today's world, however, with so many people not answering phones, doorknocks, and emails, getting this random sample is a challenge.

Given polling's margin of error and last-minute voter swings, political polls are good but imperfect estimates of likely outcomes. Immediately before the 2016 U.S. presidential election, popular polling analysis website FiveThirtyEight.com gave candidate Hillary Clinton an estimated 71 percent chance of winning. When Donald Trump was then elected, many regarded the prediction as a failure. But consider: When a prediction model estimates a 71 percent chance for one candidate, that candidate should *lose* nearly one third of the time. (Imagine a weather forecast that predicts a 70 percent chance of rain. If it then *always* rained, that would be a flawed forecast.) One analysis of 30,000 general election political predictions in 45 countries between 1942 and 2017 summed it up: Contrary to popular belief, polls are pretty accurate (Jennings & Wlezien, 2018).

The point to remember: Before accepting survey findings, think critically. Consider the sample. The best basis for generalizing is from a representative, random *sample.*

With very large samples, estimates become quite reliable. The letter *E* is estimated to represent 12.7 percent of the letters in written English. *E,* in fact, is 12.3 percent of the 925,141 letters in Melville's *Moby-Dick,* 12.4 percent of the 586,747 letters in Dickens' *A Tale of Two Cities,* and 12.1 percent of the 3,901,021 letters in 12 of Mark Twain's works (*Chance News,* 1997).

RETRIEVAL PRACTICE

RP-6 What is an unrepresentative sample, and how do researchers avoid it?

ANSWERS IN APPENDIX E

random sample a sample that fairly represents a population because each member has an equal chance of inclusion.

population all those in a group being studied, from which random samples may be drawn. (*Note:* Except for national studies, this does *not* refer to a country's whole population.)

correlation a measure of the extent to which two factors vary together, and thus of how well either factor *(variable)* predicts the other.

correlation coefficient a statistical index of the direction and strength of the relationship between two things (from −1.00 to +1.00).

Correlation

LOQ 2-5 What does it mean when we say two things are correlated, and what are positive and negative correlations?

Describing behavior is the first step toward predicting it. Naturalistic observation and surveys often show us that one trait or behavior tends to coincide with another. In such cases, we say the two **correlate**. A statistical measure (the **correlation coefficient**) helps us figure out the direction and strength of the relationship. Knowing how much aptitude test scores *correlate* with school success tells us how well the scores *predict* school success.

A *positive correlation* (above 0 to +1.00) indicates a *direct* relationship, meaning that two things increase together or decrease together. For example, height and weight are positively correlated.

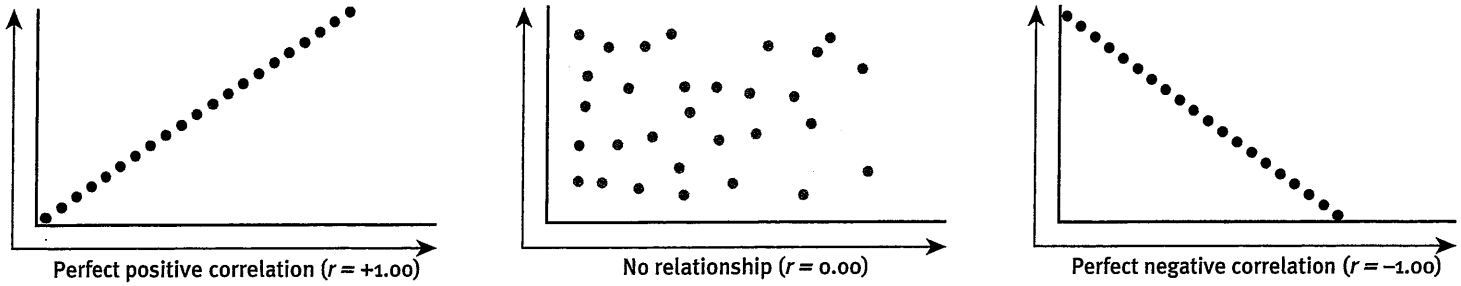


FIGURE 2.4

Scatterplots, showing patterns of correlation Correlations—abbreviated *r*—can range from +1.00 (scores for one variable increase in direct proportion to scores for another), to 0.00 (no relationship), to −1.00 (scores for one variable decrease precisely as scores for the other rise).

A *negative correlation* (below 0 to −1.00) indicates an *inverse* relationship: As one thing increases, the other decreases. Negative correlations could go as low as −1.00, which means that, like people on opposite ends of a teeter-totter, one set of scores goes down precisely as the other goes up. An example: In the fall of 2020, U.S. states' rate of mask use correlated negatively ($r = -.85$) with reported Covid-19 symptoms (CovidCast, 2020).

A coefficient near zero is a weak correlation, indicating little or no relationship.

Throughout this book, we often ask how strongly two **variables** are related: How closely related are the personality test scores for identical twins? How well do intelligence test scores predict career achievement? Do people's depression levels predict their anxiety?

In such cases, **scatterplots** can be very revealing. Each dot in a scatterplot represents the values of two variables. The three scatterplots in **FIGURE 2.4** illustrate the range of possible correlations from a perfect positive to a perfect negative. (Perfect correlations rarely occur in the real world.) A correlation is positive if two sets of scores, such as for height and weight, tend to rise or fall together.

A negative correlation isn't "bad." It simply means two sets of scores relate inversely, one set going up as the other goes down. The correlation between people's height and the distance from their head to the ceiling is strongly (perfectly, in fact) negative. Saying that a correlation is "negative" also says nothing about its strength.

Statistics can reveal what we might miss with casual observation. To demonstrate, consider the responses of 2291 Czech and Slovakian volunteers who rated, on a 1 to 7 scale, their *fear* and *disgust* related to each of 24 animals (Polák et al., 2020). With all the relevant data right in front of you (**TABLE 2.2**), can you tell whether the correlation between participants' fear and their disgust is positive, negative, or close to zero?

When comparing the columns in Table 2.2, you might not detect much of a relationship between fear and disgust. In fact, the correlation in this example is positive ($r = +.72$), as we can see if we display the data as a scatterplot (**FIGURE 2.5**).

If we don't easily recognize a strong relationship when data are presented systematically, as in Table 2.2, how much less likely are we to notice them in everyday life? To see what is right in front of us, we sometimes need statistical illumination. We can easily see evidence of gender discrimination when given statistically summarized information about job level, seniority, performance, gender, and salary. But we often see no discrimination when the same information dribbles in, case by case (Twiss et al., 1989). Single events or individuals catch our attention, especially if we want to see (or deny) bias. In contrast, statistics calculate patterns by counting every case equally.

TABLE 2.2 People's Fear and Disgust Responses to Various Animals

Animal	Average Fear	Average Disgust
Ant	2.12	2.26
Bat	2.11	2.01
Bull	3.84	1.62
Cat	1.24	1.17
Cockroach	3.10	4.16
Dog	2.25	1.20
Fish	1.15	1.38
Frog	1.84	2.48
Snake	3.32	2.47
Horse	1.82	1.11
Lizard	1.46	1.46
Louse	3.58	4.83
Maggot	2.90	4.49
Mouse	1.62	1.78
Panda	1.57	1.17
Pigeon	1.48	2.01
Rat	2.11	2.25
Rooster	1.78	1.34
Roundworm	3.49	4.79
Snail	1.15	1.69
Spider	4.39	4.47
Tapeworm	3.60	4.83
Viper	4.34	2.83
Wasp	3.42	2.84

variable anything that can vary and is practical and ethical to measure.

scatterplot a graphed cluster of dots, each of which represents the values of two variables. The slope of the points suggests the direction of the relationship between the two variables. The amount of scatter suggests the strength of the correlation (little scatter indicates high correlation).

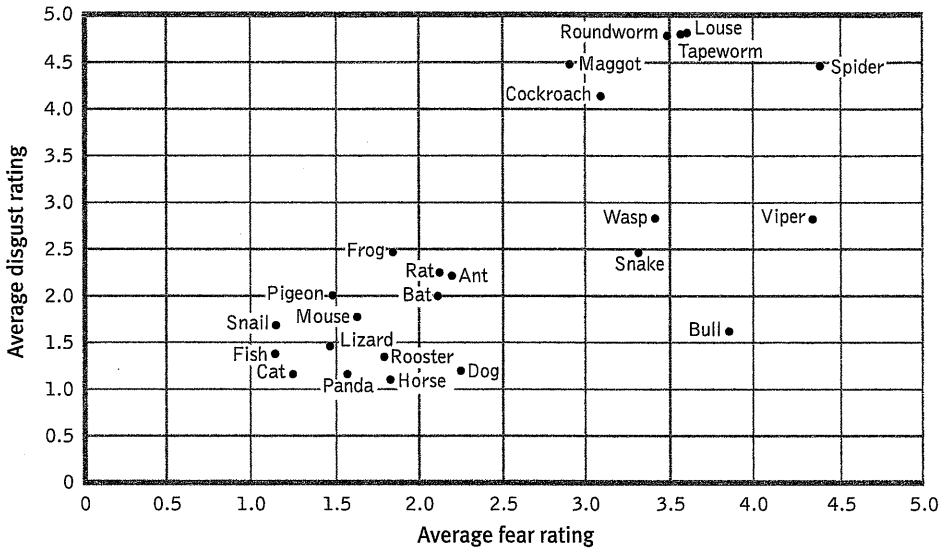


FIGURE 2.5
Scatterplot for fear and disgust felt toward 24 animals This display of average self-reported fear and disgust (each represented by a data point) reveals an upward slope, indicating a positive correlation. The considerable scatter of the data indicates the correlation is much lower than +1.00.

The point to remember: Unlike experiments, correlation coefficients tell us nothing about cause and effect. But they can help us see the world more clearly by revealing the extent to which two things relate.

RETRIEVAL PRACTICE

RP-7 Indicate whether each association is a positive correlation or a negative correlation.

1. The more husbands viewed internet pornography, the worse their marital relationships (Muusses et al., 2015). _____
2. The more time teen girls spend absorbed with online social media, the more at risk they are for depression and suicidal thoughts (Kelly et al., 2019; Twenge & Campbell, 2019). _____
3. The longer children were breast-fed, the greater their later academic achievement (Horwood & Fergusson, 1998). _____
4. The more leafy vegetables older adults eat, the less their mental decline over the ensuing 5 years (Morris et al., 2018). _____

ANSWERS IN APPENDIX E

ILLUSORY CORRELATIONS AND REGRESSION TOWARD THE MEAN

LOQ 2-6 What are *illusory correlations,* and what is *regression toward the mean?*

Correlations make clear the relationships we might otherwise miss; they also keep us from falsely assuming a relationship where there is none. When we believe there is a relationship between two things, we are likely to notice and recall instances that confirm our belief. If we believe that dreams forecast actual events, we may notice and recall confirming instances more than disconfirming instances. The result is an **illusory correlation**.

Illusory correlations can feed an illusion of control—that we can personally influence chance events. Gamblers, remembering past lucky rolls, may come to believe they influenced the roll of the dice by throwing gently for low numbers and hard for high numbers. We also struggle to separate fact from fiction due to a statistical phenomenon called **regression toward the mean**. Extreme results, such as an exceptionally low exam score, are caused by unfortunate combinations—exam topic, question difficulty, sleep deprivation, the weather. The same combination likely won't occur on the next exam, raising the probability of a higher score. Simply said, extraordinary happenings tend to be followed by more ordinary ones. Unusually high or low grades will usually regress

illusory correlation perceiving a relationship where none exists, or perceiving a stronger-than-actual relationship.

regression toward the mean the tendency for extreme or unusual scores or events to fall back (regress) toward the average.

toward students' average grades. And a team's unusually poor performance in one game will usually improve in the next.

Failure to recognize regression can lead to superstitious thinking. After berating a team for poorer-than-usual performance, a coach may—when the team regresses to more typical play—think the scolding actually worked. After lavishing praise for an exceptionally fine performance, the coach may be disappointed when a team's behavior migrates back toward its average. Ironically, then, regression toward the average can mislead us into feeling rewarded after criticizing others ("That criticism really made them work harder!") and feeling punished after praising them ("All those compliments made them slack off!") (Tversky & Kahneman, 1974).

The point to remember: When a fluctuating behavior returns to average, fancy explanations for why it does so are often wrong. Regression toward the mean is probably at work.

"Once you become sensitized to it, you see regression everywhere." — Psychologist Daniel Kahneman (1985)

Moreover, although correlational research helpfully reveals relationships, it does not explain them. If teen social media use correlates with (predicts) teen risk of depression, that may—or may not—indicate that social media use affects depression risk. Other explanations are possible (see Thinking Critically About: Correlation and Causation).

RETRIEVAL PRACTICE

RP-8 You hear the school basketball coach telling her friend that she rescued her team's winning streak by yelling at the players after an unusually bad first half. What is another explanation of why the team's performance improved?

RP-9 Length of marriage positively correlates with hair loss in men. Does this mean that marriage causes men to lose their hair (or that balding men make better husbands)?

Nancy Brown/The Image Bank/Getty Images

ANSWERS IN APPENDIX E

Experimentation

LOQ 2-8 What are the characteristics of experimentation that make it possible to isolate cause and effect?

Happy are they, remarked the Roman poet Virgil, "who have been able to perceive the causes of things." How might psychologists sleuth out the causes in correlational studies, such as the small correlation between teen girls' social media use and their risk of depression and self-harm (Olgers & Jensen, 2020)?

EXPERIMENTAL MANIPULATION Our sleuthing starts with three plain facts:

1. Beginning in 2010, worldwide smart phone and social media use mushroomed.
2. Simultaneously, Canadian, American, and British teen girls' rates of depression, anxiety, self-harm, and suicide also mushroomed (Mercado et al., 2017; Morgan, 2017; Statistics Canada, 2016).
3. Moving beyond simple correlations, in seven of nine *longitudinal* (over time) studies, teens' current social media use predicted future mental health issues (Haidt & Twenge, 2021; Zhou et al., 2020).

What do such findings mean? Is there a cause-effect connection, perhaps above a certain amount of screen time? Should parents limit their children's screen time? Even big correlational data from a million teens couldn't tell us. To identify cause and effect, researchers must **experiment**. Experiments enable researchers to isolate the effects of

experiment a research method in which an investigator manipulates one or more variables (independent variables) to observe the effect on some behavior or mental process (the dependent variable). By *random assignment* of participants, the experimenter aims to control other relevant variables that may change the research outcome.

Thinking Critically About:

Correlation and Causation

LOQ 2-7 Why do correlations enable prediction but not cause-effect explanation?

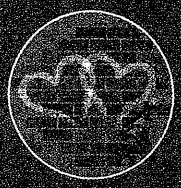
Mental illness *correlates* with smoking—meaning that those who experience mental illness are also more likely to be smokers.[1] Does this tell us anything about what *causes* mental illness or smoking? **NO.**

There may be something about smoking that leads to mental illness.

Those with mental illness may be more likely to smoke.

OR

There may be some *third variable*, such as a stressful home life, for example, that triggers *both* smoking and mental illness.



So, then, how would you interpret these recent findings?

a) Sexual hookups correlate with college women's experiencing depression.[2]

b) *Delaying* sexual intimacy correlates with positive outcomes such as greater relationship satisfaction and stability.[3]

Possible explanations:

1. Sexual restraint	→ Better mental health and stronger relationships
2. Depression	→ People being more likely to hook up
3. Some third factor, such as lower impulsivity	→ Sexual restraint, psychological well-being, and better relationships

Correlations do help us predict. Consider: Self-esteem correlates negatively with (and therefore predicts) depression. The lower people's self-esteem, the greater their risk for depression.

Possible interpretations:

1. Low self-esteem	→ Depression
2. Depression	→ Low self-esteem
3. Some third factor, such as distressing events or biological predisposition	→ Both low self-esteem and depression

You try it!

A survey of over 12,000 adolescents found that the more teens feel loved by their parents, the less likely they are to behave in unhealthy ways—having early sex, smoking, abusing alcohol and drugs, exhibiting violence.[3] What are three possible ways we could interpret that finding?[4]

***The point to remember:* Correlation does not prove causation.**

Correlation suggests a possible cause-effect relationship but does not prove it. Remember this principle and you will be wiser as you read and hear news of scientific studies.

1. Bellack, 2013. 2. Fielder et al., 2013; Willoughby et al., 2014. 3. Resnick et al., 1997. 4. *ANSWERS:* A. Parental love may produce healthy teens. B. Well-behaved teens may feel more parental love and approval. C. Some third factor, such as income or neighborhood, may influence both parental love AND teen behaviors.

experimental group in an experiment, the group exposed to the treatment, that is, to one version of the independent variable.

control group in an experiment, the group *not* exposed to the treatment; contrasts with the experimental group and serves as a comparison for evaluating the effect of the treatment.

random assignment assigning participants to experimental and control groups by chance, thus minimizing preexisting differences between the different groups.

one or more variables by (1) *manipulating the variables of interest* and (2) *holding constant ("controlling") other variables*. To do so, they often create an **experimental group**, in which people receive the treatment (such as reduced screen time), and a contrasting **control group** in which they do not.

To minimize any preexisting differences between the two groups, experimenters **randomly assign** people to each condition. Random assignment—whether with a random-number generator or by the flip of a coin—effectively equalizes the two groups. If one-third of the volunteers for an experiment can wiggle their ears, then about one-third of the people in each group will be ear wigglers. So, too, with age, intelligence, attitudes,

and other characteristics, which will be similar in the experimental and control groups. Thus, if the groups differ at the experiment's end, we can surmise that the treatment had an effect. (Note the difference between random *sampling*—which creates a representative survey sample—and random *assignment*, which equalizes the experimental and control groups.)

So, what do *experiments* reveal about the relationship between girls' social media use and their risk of depression and self-harm? One experiment identified nearly 1700 people who agreed to deactivate their Facebook account for 4 weeks (Allcott et al., 2020). Compared with people in the control group, those randomly assigned to the deactivation group spent more time watching TV and socializing with friends and family—and they reported lower depression, and greater happiness and satisfaction with their lives (and less postexperiment Facebook use). Less Facebook time meant a happier life.

The debate over the effects of prolonged social media use is ongoing. For now, most researchers agree that unlimited teen social media use poses a modest mental health risk. With more large correlational and longitudinal studies, and more experiments, researchers will refine this tentative conclusion.

The point to remember: Correlational studies, which uncover naturally occurring relationships, are complemented by experiments, which manipulate a variable to determine its effect.

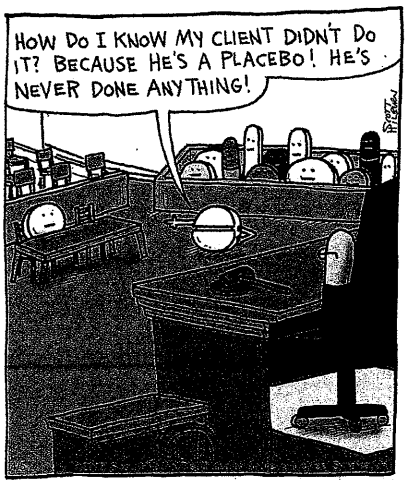
PROCEDURES AND THE PLACEBO EFFECT Consider, then, how we might assess therapeutic interventions. Our tendency to seek new remedies when we are ill or emotionally down can produce misleading testimonies. If three days into a cold we start taking zinc tablets and find our cold symptoms lessening, we may credit the pills rather than the cold naturally subsiding. In the 1700s, bloodletting *seemed* effective. When the patient actually survived, this "treatment" was credited for the recovery. When patients didn't survive, the practitioner inferred the disease was too advanced to be reversed. So, whether or not a remedy is truly effective, enthusiastic users will probably endorse it. To determine its effect, we must control for other variables.

And that is precisely how new drugs and new methods of psychological therapy are evaluated (more on this in the Therapy modules). Investigators randomly assign participants in these studies to research groups. One group receives a pseudotreatment—an inert *placebo* (perhaps a pill with no drug in it). The other group receives a treatment, such as an antidepressant medication. (You can think of the placebo versus the actual drug as "trick or treatment.") The participants are often *blind* (uninformed) about what treatment, if any, they are receiving. If the study is using a **double-blind procedure**, neither the participants nor those who administer the drug and collect the data will know which group is receiving the treatment.

In double-blind studies, researchers check a treatment's actual effects apart from the participants' and the staff's belief in its healing powers. Just *thinking* you are getting a treatment can boost your spirits, relax your body, and relieve your symptoms. This **placebo effect** is well documented in reducing pain, depression, anxiety, and auditory hallucinations in schizophrenia (Dollfus et al., 2016; Kirsch, 2010). Athletes have run faster when given a supposed performance-enhancing drug (McClung & Collins, 2007). Decaf-coffee drinkers have reported increased vigor and alertness when they thought their brew had caffeine in it (Dawkins et al., 2011). People have felt better after receiving a phony mood-enhancing drug (Michael et al., 2012). And the more expensive the placebo, the more "real" it seems to us—a fake pill that costs $2.50 worked better than one costing 10 cents (Waber et al., 2008). To know how effective a therapy really is, researchers must control for a possible placebo effect.

double-blind procedure an experimental procedure in which both the research participants and the research staff are uninformed (blind) about whether the research participants have received the treatment or a placebo. Commonly used in drug-evaluation studies.

placebo [pluh-SEE-bo; Latin for "I shall please"] effect experimental results caused by expectations alone; any effect on behavior caused by the administration of an inert substance or condition, which the recipient assumes is an active agent.



RETRIEVAL PRACTICE

RP-10 What measures do researchers use to prevent the *placebo effect* from confusing their results?

ANSWERS IN APPENDIX E

independent variable in an experiment, the variable that is manipulated; the variable whose effect is being studied.

confounding variable in an experiment, a variable other than the variable being studied that might influence a study's results.

dependent variable in an experiment, the variable that is measured; the variable that may change when the independent variable is manipulated.

A similar experiment on a drug approved to increase women's sexual arousal produced a result described as, um, anticlimactic—an additional "half of one satisfying sexual encounter a month" (Ness, 2016; Tavernise, 2016).

INDEPENDENT AND DEPENDENT VARIABLES

Here is an even more potent example: The drug Viagra was approved for use after 21 clinical trials. One trial was an experiment in which researchers randomly assigned 329 men with erectile disorder to either an experimental group (Viagra takers) or a control group (placebo takers given an identical-looking pill). The procedure was double-blind—neither the men taking the pills nor the person giving them knew what participants were receiving. The result: At peak doses, 69 percent of Viagra-assisted attempts at intercourse were successful, compared with 22 percent for men receiving the placebo (Goldstein et al., 1998). Follow-up experiments replicated Viagra's helpful effect (Fink et al., 2002). Viagra performed.

These simple experiments manipulated just one variable: the drug (Viagra versus no Viagra). We call this experimental variable the **independent variable** because we can vary it *independently* of other variables, such as the men's age, weight, and personality. Other variables that can potentially influence a study's results are called **confounding variables**. Random assignment controls for possible confounding variables.

Experiments examine the effect of one or more independent variables on some measurable behavior, called the **dependent variable** because it can vary *depending* on what occurs during the experiment. Both variables are given precise *operational definitions*, which specify the procedures that manipulate the independent variable (the exact drug dosage and timing in this study) or measure the dependent variable (the men's responses to questions about their sexual performance). These definitions offer a level of precision that enables others to replicate the study. (See **FIGURE 2.6** for the Facebook experiment design.)

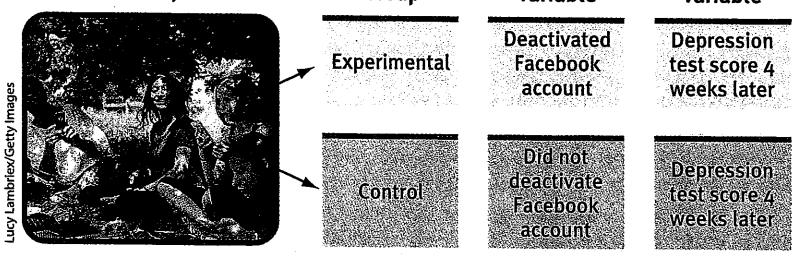
Let's pause to check your understanding using a simple psychology experiment: To test the effect of perceived ethnicity on the availability of rental housing, Adrian Carpusor and William Loges (2006) sent identically worded email inquiries to 1115 Los Angeles-area landlords. The researchers varied the sender's name and tracked the percentage of positive replies (invitations to view the apartment in person). "Patrick McDougall," "Said Al-Rahman," and "Tyrell Jackson" received, respectively, 89 percent, 66 percent, and 56 percent invitations. In this experiment, what was the independent variable? The dependent variable?[5]

"[We must guard] against not just racial slurs, but ... against the subtle impulse to call Johnny back for a job interview, but not Jamal." — U.S. President Barack Obama, eulogy for state senator and church-shooting victim Clementa Pinckney, June 26, 2015

Experiments can also help us evaluate social programs. Do early childhood education programs boost impoverished children's chances for success? What are the effects of different antismoking campaigns? Do school sex-education programs reduce teen pregnancies? To answer such questions, we can experiment: If an intervention is welcomed but resources are scarce, we could use a lottery to randomly assign some people (or regions) to experience the new program and others to a control condition. If later the two groups differ, the intervention's effect will be supported (Passell, 1993).

Let's recap. A *variable* is anything that can vary (social media exposure, erectile function, landlord responses—anything within the bounds of what is feasible and ethical to measure). Experiments aim to *manipulate* an *independent* variable, *measure* a *dependent* variable, and *control confounding* variables. An experiment has at least two different conditions: an *experimental condition* and a *comparison* or *control condition*. *Random assignment*

FIGURE 2.6
Experimentation To establish causation, psychologists control for confounding variables by randomly assigning some participants to an experimental group, others to a control group. Measuring the dependent variable (depression score) will determine the effect of the independent variable (social media exposure).



[5]The independent variable, which the researchers manipulated, was the implied ethnicity of the applicants' names. The dependent variable, which researchers measured, was the rate of positive responses from the landlords.

works to minimize preexisting differences between the groups before any treatment effects occur. In this way, an experiment tests the effect of at least one independent variable (what we manipulate) on at least one dependent variable (the outcome we measure).

RETRIEVAL PRACTICE

RP-11 By using *random assignment,* researchers are able to control for _____ _____, which are other variables besides the independent variable(s) that may influence research results.

RP-12 Match the term on the left (i through iii) with the description on the right (a through c).

i. Double-blind procedure	a. helps researchers generalize from a small set of survey responses to a larger population
ii. Random sampling	b. helps minimize preexisting differences between experimental and control groups
iii. Random assignment	c. controls for the placebo effect; neither researchers nor participants know who receives the real treatment

RP-13 Why, when testing a new drug to control blood pressure, would we learn more about its effectiveness from giving it to half the participants in a group of 1000 than to all 1000 participants?

ANSWERS IN APPENDIX E

Research Design

LOQ 2-9 How would you know which research design to use?

Throughout this book, you will read about amazing psychological science discoveries. But how do psychological scientists choose research methods and design their studies in ways that provide meaningful results? Understanding how research is done—how testable questions are developed and studied—is key to appreciating all of psychology. **TABLE 2.3** compares the features of psychology's main research methods. In other modules, you will read about other research designs, including *twin studies* and *cross-sectional* and *longitudinal research*.

In psychological research, no questions are off limits, except untestable (or unethical) ones: Does free will exist? Are people born evil? Is there an afterlife? Psychologists can't

TABLE 2.3 Comparing Research Methods

Research Method	Basic Purpose	How Conducted	What Is Manipulated	Weaknesses
Descriptive	To observe and record behavior	Do case studies, naturalistic observations, or surveys	Nothing	No control of variables; single cases may be misleading
Correlational	To detect naturally occurring relationships; to assess how well one variable predicts another	Collect data on two or more variables; no manipulation	Nothing	Cannot specify cause and effect
Experimental	To explore cause and effect	Manipulate one or more variables; use random assignment	The independent variable(s)	Sometimes not feasible; results may not generalize to other contexts; not ethical to manipulate certain variables

test those questions. But they *can* test whether free-will beliefs, aggressive personalities, and a belief in life after death influence how people think, feel, and act (Dechesne et al., 2003; Shariff et al., 2014; Webster et al., 2014).

Having chosen their question, psychologists then select the most appropriate research design—*experimental, correlational, case study, naturalistic observation, twin study, longitudinal,* or *cross-sectional*—and determine how to set it up most effectively. They consider how much money and time are available, ethical issues, and other limitations. For example, it wouldn't be ethical for a researcher studying child development to use the experimental method and randomly assign children to loving versus abusive homes.

Next, psychological scientists decide how to measure the behavior or mental process being studied. For example, researchers studying aggressive behavior could measure participants' willingness to blast a stranger with supposed intense noise.

Researchers want to have confidence in their findings, so they carefully consider confounding variables—variables other than those being studied that may affect their interpretation of results.

Psychological research is a creative adventure. Researchers *design* each study, *measure* target behaviors, *interpret* results, and learn more about the fascinating world of behavior and mental processes along the way.

ASK YOURSELF

If you could conduct a study on any psychological question, which question would you choose? How would you design the study?

Predicting Everyday Behavior

LOQ 2-10 How can simplified laboratory experiments help us understand general principles of behavior?

When you see or hear about psychological research, do you ever wonder whether people's behavior in the lab will predict their behavior in everyday life? Does detecting the blink of a faint red light in a dark room say anything useful about flying an airplane at night? After viewing a violent, sexually explicit film, does a man's increased willingness to push buttons that he thinks will deliver a noise blast to a woman really say anything about whether viewing violent pornography makes a man more likely to abuse a woman?

Before you answer, consider: The experimenter *intends* the laboratory environment to be a simplified reality—one that simulates and controls important features of everyday life. Just as a wind tunnel lets airplane designers re-create airflow forces under controlled conditions, a laboratory experiment lets psychologists re-create psychological forces under controlled conditions. An experiment's purpose is not to re-create the exact behaviors of everyday life, but to test *theoretical principles* (Mook, 1983). In aggression studies, deciding whether to push a button that delivers a noise blast may not be the same as slapping someone in the face, but the principle is the same. *It is the resulting principles—not the specific findings—that help explain everyday behaviors.*

When psychologists apply laboratory research on aggression to actual violence, they are applying theoretical principles of aggressive behavior, principles they have refined through many experiments. Similarly, it is the principles of the visual system, developed from experiments in artificial settings (such as looking at red lights in the dark), that researchers apply to more complex behaviors such as night flying. And many investigations show that principles derived in the laboratory do typically generalize to the everyday world (Mitchell, 2012).

The point to remember: Psychological science focuses less on specific behaviors than on revealing general principles that help explain many behaviors.

Psychology's Research Ethics

LOQ 2-11 Why do psychologists study animals, and what ethical research guidelines safeguard human and animal welfare? How do psychologists' values influence what they study and how they apply their results?

We have reflected on how a scientific approach can restrain biases. We have seen how case studies, naturalistic observations, and surveys help us describe behavior. We have also noted that correlational studies assess the association between two variables, showing how well one predicts another. We have examined the logic that underlies experiments, which use control conditions and random assignment of participants to isolate the causal effects of an independent variable on a dependent variable.

Yet even knowing this much, you may still be approaching psychology with a mixture of curiosity and apprehension. So, before we plunge in, let's entertain some common questions about psychology's ethics and values.

Studying and Protecting Animals

Many psychologists study nonhuman animals because they find them fascinating. They want to understand how different species learn, think, and behave. Psychologists also study animals to learn about people. We humans are not *like* animals; we *are* animals, sharing a common biology. Animal experiments have therefore led to treatments for human diseases—insulin for diabetes, vaccines to prevent polio and rabies, transplants to replace defective organs.

"Rats are very similar to humans except that they are not stupid enough to purchase lottery tickets." — Dave Barry, 2002

Humans are complex. But some of the same processes by which we learn are present in other animals, even sea slugs and honeybees. The simplicity of the sea slug's nervous system is precisely what makes it so revealing of the neural mechanisms of learning. Ditto for the honeybee, which resembles us humans in how it learns to cope with stress (Dinges et al., 2017).

Sharing such similarities, should we not respect our animal relatives? The animal protection movement protests the use of animals in psychological, biological, and medical research. "We cannot defend our scientific work with animals on the basis of the similarities between them and ourselves and then defend it morally on the basis of differences," noted Roger Ulrich (1991). In U.S. national surveys, half of adults oppose and half favor "the use of animals in scientific research"—with support greater among those most informed about science (Strauss, 2018).

Out of this heated debate, two issues emerge. The basic one is whether it is right to place the well-being of humans above that of other animals. In experiments on stress and cancer, is it right that mice get tumors in the hope that people might not? Was it right that researchers exposed monkeys to a coronavirus in the search for a Covid-19 vaccine (Shandrashekar et al., 2020)? Humans slaughter for meat 80 billion animals a year (Ritchie & Roser, 2019). Is our use and consumption of other animals as natural as the behavior of carnivorous hawks, cats, and whales?

"Please do not forget those of us who suffer from incurable diseases or disabilities who hope for a cure through research that requires the use of animals." — Psychologist Dennis Feeney (1987)

For those who give human life top priority, a second issue emerges: What safeguards should protect the well-being of animals in research? One survey of animal researchers gave an answer. Some 98 percent supported government regulations protecting primates, dogs, and cats, and 74 percent also supported regulations providing for the humane care of rats and mice (Plous & Herzog, 2000). Many professional associations and funding agencies already have such guidelines. British Psychological Society (BPS) guidelines call for housing animals under reasonably natural living conditions, with companions for social animals (Lea, 2000). American Psychological Association (APA) guidelines state that researchers must provide "humane care and healthful conditions" and that testing should "minimize discomfort" (APA, 2012). The European Parliament also mandates standards for animal care and housing (Vogel, 2010). Most universities screen research proposals, often through an animal care ethics committee, and laboratories are regulated and inspected.

"The greatness of a nation can be judged by the way its animals are treated." — Mahatma Gandhi, 1869–1948

MARY ALTAFFER/AP Photo

Animal research benefiting animals Psychologists have helped zoos enrich animal environments—for example, by giving animals more choices to reduce the *learned helplessness* of captivity (Kurtycz, 2015; Weir, 2013). Thanks partly to research on the benefits of novelty, control, and stimulation, these gorillas are enjoying an improved quality of life in New York's Bronx Zoo.

Animals have themselves benefited from animal research. One Ohio team of research psychologists measured stress hormone levels in samples of millions of dogs brought each year to animal shelters. They devised handling and stroking methods to reduce stress and ease the dogs' transition to adoptive homes (Tuber et al., 1999). Other studies have helped improve care and management in animals' natural habitats. By revealing our behavioral kinship with animals and the remarkable intelligence of chimpanzees, gorillas, and other animals, experiments have also led to increased empathy and protection for them. At its best, a psychology concerned for humans and sensitive to animals serves the welfare of both.

Studying and Protecting Humans

What about human participants? Does the image of white-coated scientists seeming to deliver electric shocks trouble you? Actually, most psychological studies are free of such stress. Blinking lights, flashing words, and pleasant social interactions are more common.

Occasionally, researchers do temporarily stress or deceive people, but only when they believe it is essential to a justifiable end, such as understanding and controlling violent behavior or studying mood swings. Many experiments won't work if participants know everything beforehand. (Wanting to be helpful, the participants might try to confirm the researcher's predictions.)

Some of psychology's famous experiments used stressful and deceptive methods that are considered unacceptable today. These early psychologists deprived baby monkeys of their mothers, conditioned human babies to burst into tears, and semistarved conscientious objectors. More to come on each of these in other modules.

Today's ethics codes, from the APA and Britain's BPS, urge researchers to (1) obtain potential participants' **informed consent** to take part, (2) protect participants from greater-than-usual harm and discomfort, (3) keep information about individual participants confidential, and (4) fully **debrief** people (explain the research afterward, including any temporary deception). To enforce these ethical standards, universities and research organizations have *Institutional Review Boards* that screen research proposals and safeguard "the rights, welfare and well-being of human research participants" (NIEHS, 2019).

RETRIEVAL PRACTICE

RP-14 How are animal and human research participants protected?

ANSWERS IN APPENDIX E

Ensuring Scientific Integrity

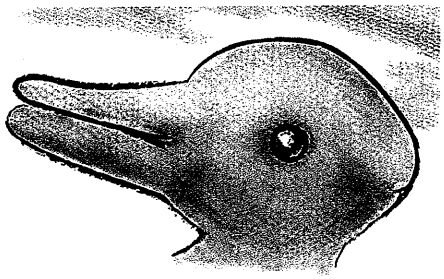
In science, as in everyday life, mistakes happen. When data get accidentally miscomputed or misreported, that's forgivable and correctable. What's not acceptable—and will get a scientist banished from the profession—is fraud. Leading scientists cite honesty as the most important scientific value, followed by curiosity and perseverance (*Nature*, 2016). The worldwide general public rates doctors and scientists as the most trusted professionals, followed by judges and members of the armed forces (Ipsos, 2019). To seek career advancement by plagiarizing another's words or ideas, or to make up data, is to risk finding one's career ended. This was the case when a Dutch psychologist fabricated data that made it into 58 research articles—fakery that was sniffed out by alert colleagues (Retraction Watch, 2015).

Fake science also has the potential to cause great harm. This happened in 1998 when a now-disbarred British physician published an article in the prestigious *Lancet*, reporting a dozen cases in which British children given the measles, mumps, and rubella (MMR) vaccine supposedly developed autism afterward. Other studies failed to reproduce the finding (replication matters!) (Hviid et al., 2019). An investigation revealed a fraud—with falsified data—and the journal retracted the report (Godlee, 2011). Alas, by then the widely publicized finding—"the most damaging medical hoax of the last 100 years" (Flaherty, 2011)—had produced an "anti-vax" movement and declining vaccination

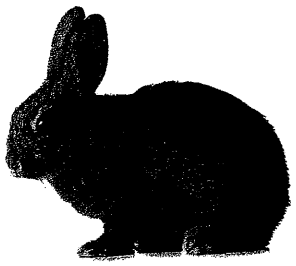
informed consent giving potential participants enough information about a study to enable them to choose whether they wish to participate.

debriefing the postexperimental explanation of a study, including its purpose and any deceptions, to its participants.

rates. Instead of following the typical path toward disease elimination, U.S. measles rates in 2019 rose to their highest levels in 25 years (CDC, 2019; Graham et al., 2019). Unvaccinated children may suffer long-term harm or even death, as well as placing at risk those children too young to be fully vaccinated. Though the science was self-correcting, the damage lingers on. Today, the discredited Wakefield continues to urge people to avoid other vaccines, including those for Covid-19 (Jamison, 2020). (In September 2020, only one-third of Americans said they would get a Covid-19 vaccine as soon as they could [Elbeshbihi & King, 2020].) Nevertheless, the good news is that scientific scrutiny, complete with replication, can inform and protect us.



(a)



(b)

Mike Kemp/Rubberball/Getty Images

FIGURE 2.7
What do you see? Our expectations influence what we perceive in (a). Did you see a duck or a rabbit? Show some friends this image with the rabbit photo (b) covered up and see if they are more likely to perceive a duck. (Inspired by Shepard, 1990.)

Values in Psychology

Values affect what we study, how we study it, and how we interpret results. Researchers' values influence choice of research topics. Should we study worker productivity or worker morale? Cultural differences or social injustice? Conformity or independence? Values can also color "the facts"—our observations and interpretations. Sometimes we see what we want or expect to see (**FIGURE 2.7**).

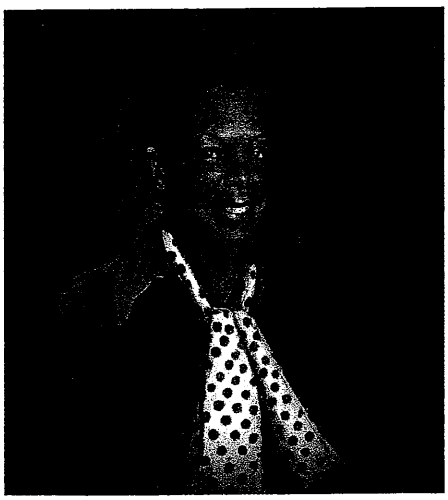
Even the words we use to describe traits and tendencies can reflect our values. In psychology and in everyday speech, labels describe and labels evaluate: One person's *rigidity* is another's *consistency*. One person's *faith* is another's *fanaticism*. One person's *adultery* is another's *open marriage*. Our labeling someone as *firm* or *stubborn, careful* or *picky, discreet* or *secretive* reveals our own attitudes.

So, values inform psychological science—and psychological science has the power to persuade. This may lead some to feel distrustful: Is psychology dangerously powerful? Might it be used to manipulate people? Knowledge, like all power, can be used for good or evil. Nuclear power has been used to light up cities—and to demolish them. Persuasive power has been used to educate people—and to deceive them. Although psychology does have the power to deceive, its purpose is to enlighten. Every day, psychologists explore ways to enhance learning, creativity, and compassion. Psychology speaks to many of our world's great problems—extremist terrorism, political corruption, economic inequality, climate change, prejudice, refugee crises—all of which involve attitudes and behaviors. Psychology also speaks to our deepest longings—for love, for happiness, for meaning. Psychology cannot address all of life's great questions, but it speaks to some mighty important ones.

ASK YOURSELF

What other questions or concerns do you have about psychology?

Psychology speaks In making its historic 1954 school desegregation decision, the U.S. Supreme Court cited the expert testimony and research of psychologists Mamie Phipps Clark and Kenneth Clark (1947). The Clarks reported that, when given a choice between Black and White dolls, most African American children chose the White doll, which indicated that they had likely absorbed and internalized anti-Black prejudice.



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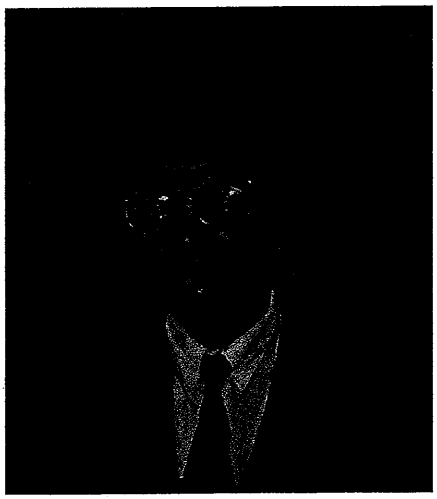

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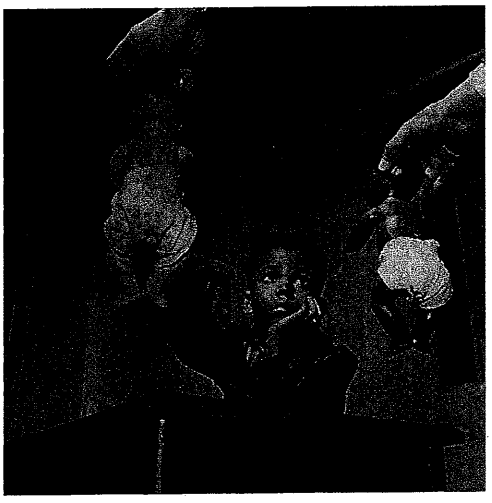

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MODULE 2

REVIEW Research Strategies: How Psychologists Ask and Answer Questions

LEARNING OBJECTIVES

Test Yourself Answer these repeated Learning Objective Questions on your own (before "showing" the answers here, or checking the answers in Appendix D) to improve your retention of the concepts (McDaniel et al., 2009, 2015).

LOQ 2-1 How does our everyday thinking sometimes lead us to a wrong conclusion?

LOQ 2-2 Why are we so vulnerable to believing untruths?

LOQ 2-3 How do theories advance psychological science?

LOQ 2-4 How do psychologists use case studies, naturalistic observations, and surveys to observe and describe behavior, and why is random sampling important?

LOQ 2-5 What does it mean when we say two things are correlated, and what are positive and negative correlations?

LOQ 2-6 What are *illusory correlations,* and what is *regression toward the mean?*

LOQ 2-7 Why do correlations enable prediction but not cause-effect explanation?

LOQ 2-8 What are the characteristics of experimentation that make it possible to isolate cause and effect?

LOQ 2-9 How would you know which research design to use?

LOQ 2-10 How can simplified laboratory experiments help us understand general principles of behavior?

LOQ 2-11 Why do psychologists study animals, and what ethical research guidelines safeguard human and animal welfare? How do psychologists' values influence what they study and how they apply their results?

TERMS AND CONCEPTS TO REMEMBER

Test Yourself Write down the definition in your own words, then check your answer.

hindsight bias, p. 21
peer reviewers, p. 24
theory, p. 25
hypothesis, p. 25
operational definition, p. 26
replication, p. 26
preregistration, p. 26
case study, p. 27
naturalistic observation, p. 27
survey, p. 29
random sample, p. 30
population, p. 30
correlation, p. 30
correlation coefficient, p. 30
variable, p. 31
scatterplot, p. 31
illusory correlation, p. 32
regression toward the mean, p. 32
experiment, p. 33
experimental group, p. 34
control group, p. 34
random assignment, p. 34
double-blind procedure, p. 35
placebo [pluh-SEE-bo] effect, p. 35
independent variable, p. 36
confounding variable, p. 36
dependent variable, p. 36
informed consent, p. 40
debriefing, p. 40

MODULE TEST

Test Yourself Answer the following questions on your own first, then "show" the answers here, or check your answers in Appendix E.

1. _____ _____ refers to our tendency to perceive events as obvious or inevitable after the fact.

2. As scientists, psychologists
   - **a.** keep their methods private so others will not repeat their research.
   - **b.** assume the truth of articles published in leading scientific journals.
   - **c.** reject evidence that competes with traditional findings.
   - **d.** are willing to ask questions and to reject claims that cannot be verified by research.

3. A theory-based prediction is called a(n) _____.

4. Which of the following is NOT one of the *descriptive* methods psychologists use to observe and describe behavior?
   - **a.** A case study
   - **b.** Naturalistic observation
   - **c.** Correlational research
   - **d.** A phone survey

5. For your survey, you need to establish a group of people who represent your country's entire adult population. To do this, you will need to question a _____ sample of the population.

6. A study finds that the more childbirth training classes women attend, the less pain medication they require during childbirth. This finding can be stated as a _____ (positive/negative) correlation.

7. A _____ provides a visual representation of the direction and the strength of a relationship between two variables.

8. In a _____ correlation, the scores rise and fall together; in a(n) _____ correlation, one score falls as the other rises.
   - **a.** positive; negative
   - **b.** positive; illusory
   - **c.** negative; weak
   - **d.** strong; weak

9. In a study, people who were afraid of cockroaches tended also to be disgusted by them. This suggests that the correlation between fear of and disgust for cockroaches is _____ (positive/negative).

10. How can regression toward the mean influence our interpretation of events?

11. Knowing that two events are correlated provides
    a. a basis for prediction.
    b. an explanation of why the events are related.
    c. proof that as one increases, the other also increases.
    d. an indication that an underlying third variable is at work.

12. Here are some recently reported correlations, with interpretations drawn by journalists. Knowing just these correlations, can you come up with other possible explanations for each of these?
    a. Alcohol use is associated with violence. (One interpretation: Drinking triggers or unleashes aggressive behavior.)
    b. Educated people live longer, on average, than less-educated people. (One interpretation: Education lengthens life and enhances health.)
    c. Teens engaged in team sports are less likely to use drugs, smoke, have sex, carry weapons, and eat junk food than are teens who do not engage in team sports. (One interpretation: Team sports encourage healthy living.)
    d. Adolescents who frequently see smoking in movies are more likely to smoke. (One interpretation: Movie stars' behavior influences impressionable teens.)

13. To explain behaviors and clarify cause and effect, psychologists use _____.

14. To test the effect of a new drug on depression, we randomly assign people to control and experimental groups. Those in the control group take a pill that contains no medication. This pill is a _____.

15. In a double-blind procedure,
    a. only the participants know whether they are in the control group or the experimental group.
    b. experimental and control group members will be carefully matched for age, sex, income, and education level.
    c. neither the participants nor the researchers know who is in the experimental group or control group.
    d. someone separate from the researcher will ask people to volunteer for the experimental group or the control group.

16. A researcher wants to determine whether noise level affects workers' blood pressure. In one group, the researcher varies the level of noise in the environment and records participants' blood pressure. In this experiment, the level of noise is the _____.

17. The laboratory environment is designed to
    a. exactly recreate the events of everyday life.
    b. recreate psychological forces under controlled conditions.
    c. recreate psychological forces under random conditions.
    d. minimize the use of animals and humans in psychological research.

18. In defending their experimental research with animals, psychologists have noted that
    a. animals' physiology and behavior can tell us much about our own.
    b. animal experimentation sometimes helps animals as well as humans.
    c. animals are fascinating creatures and worthy of study.
    d. all of these statements are correct.

MODULE

3 Statistical Reasoning in Everyday Life

For psychological scientists, **statistics** are important tools. Yet a basic ability to understand statistics can benefit *anyone*. To be an educated critical thinker is to apply simple statistical principles to everyday reasoning. And there's good news: To think smarter about data, we needn't memorize complicated formulas. We need merely to be statistically literate.

Statistical Literacy

LOQ 3-1 Why does statistical literacy matter?

"There are guys that've been vaccinated that have contracted Covid," exclaimed vaccine-shunning, Covid-infected Green Bay Packers quarterback Aaron Rodgers (2021a). "This idea that it's the pandemic of the unvaccinated, it's just a total lie" (2021b).

statistics using mathematical methods to understand numerical information *(data)*.

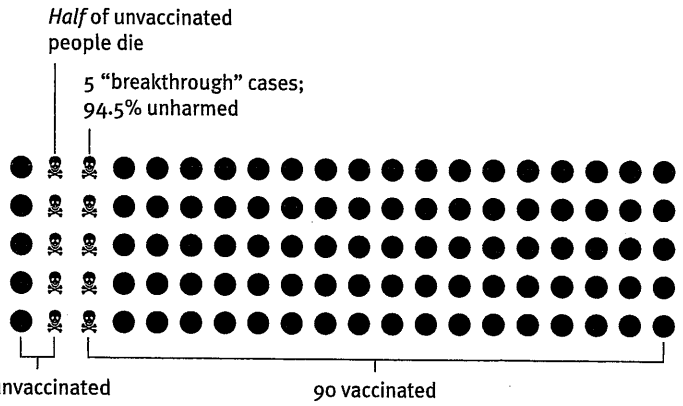


FIGURE 3.1
Statistical literacy for vaccines Imagine that you live in a town with a population of 100 people. Your local media announce that, among people dying of a pandemic virus, half were vaccinated. So, the vaccine was useless, concludes your neighbor, Bea Ware. But Bea fails to consider the *vaccination* base rate of 90 percent. The death rate among the vaccinated is 5 of 90 (5.5 percent). The death rate among the *unvaccinated* is 5 of 10 (50 percent). That's 9 times as great![6] Statistically literate people consider not just simple numbers, but also *rates*.

Rogers could have benefited from *statistical literacy*—understanding statistics and what they mean. Like many who refused to take the vaccine, Rodgers not only doubted the vaccine's effectiveness, he also felt confident in his power to avoid the disease. But even among those who got the vaccine, many doubted its efficacy. Consider the irony, noted U.S. Surgeon General Vivek Murthy (2021): "Vaccinated people may overestimate their peril, just as unvaccinated people may underestimate it."

National surveys consistently revealed that those unvaccinated were, like Aaron Rodgers, *much* less likely to fear the virus (CBS, 2021; KFF, 2021; YouGov, 2021). You read that right: A slight majority of those who were protected by vaccination still feared the virus, while most of those unvaccinated did not fear it. Moreover, those who were unvaccinated—and thus at vastly greater risk of contracting, transmitting, and being seriously sickened by the virus—were also much *less* likely to protect themselves and others by wearing masks (Tyson et al., 2021).

The confusion over Covid's risks and the vaccines' protectiveness stemmed partly from a lack of statistical literacy. Many people simply did not comprehend this key finding: Of 74,000 participants in the clinical trials of five Covid vaccines, the number who were hospitalized or died of Covid was ... zero (Leonhardt, 2021).

Translating statistical data into clear language is a challenge, and those who try sometimes mess up. For example, National Public Radio (2020) explained that, with a 50 percent effective vaccine, "If you vaccinate 100 people, 50 people will not get the disease." This implied that with a 95 percent effective vaccine, we have a 5 percent chance of getting the disease. Actually, the news was much, much better: During the Pfizer/BioNTech clinical trial, for example, only 8 of 170 Covid cases (5 percent) were among vaccinated people, making the vaccine "95 percent effective." But that's 8 out of nearly 22,000—less than 1/10th of one percent—of the vaccinated clinical trial participants (none of whom got sick enough to be hospitalized). To assess vaccine effectiveness, it isn't enough to know simply what percent of sick or hospitalized people were vaccinated. We must also know what percent of the whole population is vaccinated (**FIGURE 3.1**). Moreover, for Covid-19, given that older people are at more risk—but also more likely to have been vaccinated—we would need to compare illness or death rates among vaccinated and unvaccinated people *of the same age*.

We need to look beyond simple numbers, such as the mere number of "breakthrough" Covid cases (those that occur in the vaccinated). Failing to reason statistically can lead us to fear some health dangers too little, which contributed to more than 800,000 Americans dying of Covid by the end of 2021—more than died in all twentieth century U.S. wars combined.

A lack of statistical literacy can also lead us to fear other supposed health dangers too *much* (Gigerenzer, 2010). In the 1990s, the British press reported a study showing that women taking a particular contraceptive pill had a 100 percent increased risk of blood clots that could produce strokes. The story went viral, causing thousands of women to stop taking the pill. What happened as a result? A wave of unwanted pregnancies and an estimated 13,000 additional abortions (which, like other medical procedures, also are associated with increased blood-clot risk). Distracted by big, round numbers, few people focused on the study's actual findings: A 100 percent increased risk, indeed—but only from 1 in 7000 to 2 in 7000. Such false alarms underscore the need to think critically, to teach statistical reasoning, and to present statistical information more transparently.

Statistical misinformation also gets fed by off-the-top-of-the-head estimates. Someone throws out a big, round number. Others echo it, and before long the big, round number becomes public misinformation. Three examples:

- ***Ten percent of people are gay.*** Or is it 2 to 4 percent, as suggested by various national surveys?

[6]The example is inspired by ourworldindata.org/covid-deaths-by-vaccination, which also documented that the U.S. Covid-19 death rate, as of October 2, 2021, was 13 times greater among the unvaccinated than the vaccinated.

- *We ordinarily use only 10 percent of our brain.* Or is it closer to 100 percent?
- *To be healthy, walk 10,000 steps a day.* Or will 8500 or 13,000 steps do the trick? How about swimming or jogging (Mull, 2019)?

If you find an attention-grabbing headline presented *without evidence*—that nationally there are 1 million teen pregnancies, 2 million homeless seniors, or 3 million alcohol-related motor vehicle accidents—you can be pretty sure that someone is estimating. If they want to emphasize the problem, they will be motivated to estimate high. If they want to minimize the problem, they will estimate low. *The point to remember:* Think critically when you encounter big, round, undocumented numbers.

descriptive statistics using statistical methods to provide a simple summary of data.

When setting goals, we love big, round numbers. We're far more likely to want to lose 20 pounds than 19 or 21 pounds (or an even 10 kilograms rather than 9.07 kilograms). And U.S. high school students are more likely to retake the Scholastic Aptitude Test (SAT) if they score just below a round number, such as 1100, rather than just above (Pope & Simonsohn, 2011).

Descriptive Statistics

Once researchers have gathered their data, they may organize that data using **descriptive statistics**. One way to do this is to convert the data into a simple *bar graph*, as in FIGURE 3.2, which displays a distribution of different brands of trucks still on the road after a decade. When reading statistical graphs such as this one, take care. It's easy to design a graph to make a difference look big (Figure 3.2a) or small (Figure 3.2b). The secret lies in how you label the vertical scale (the *y-axis*).

The point to remember: Think smart. When interpreting graphs, consider the scale labels and note their *range*.

ASK YOURSELF

Think of a time when you used statistics to make a point—maybe in class, in a paper, or in a discussion with a friend or family member. Looking back, were the data you cited credible and accurate? How do you know?

RETRIEVAL PRACTICE

RP-1 A truck manufacturer offered Figure 3.2's graph (a)—with actual brand names included—to suggest the much greater durability of its trucks. What does graph (b) make clear about the varying durability, and how is this accomplished?

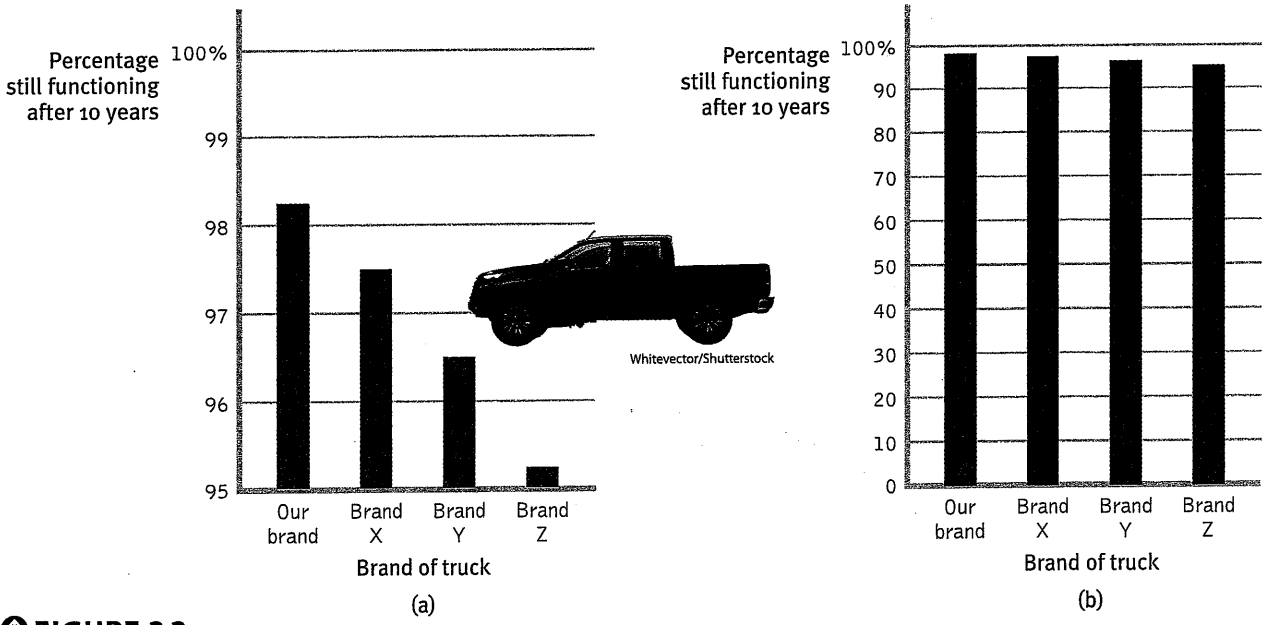


FIGURE 3.2
Read the scale labels

ANSWERS IN APPENDIX E

mode the most frequently occurring score(s) in a distribution.

mean the arithmetic average of a distribution, obtained by adding the scores and then dividing by the number of scores.

median the middle score in a distribution; half the scores are above it and half are below it.

range the difference between the highest and lowest scores in a distribution.

Measures of Central Tendency

LOQ 3-2 How do we describe data using three measures of central tendency?

The next step is to summarize the data using a *measure of central tendency*—a single score that represents a whole *distribution* of scores. The simplest measure is the **mode**, the most frequently occurring score or scores. (A *bimodal distribution* occurs when there are two most frequently occurring scores.) What is your favorite number? One global survey found that the most frequently occurring response—the mode—was *seven* (Bellos, 2014). (Was that yours?) The most familiar measure is the **mean**, or arithmetic average—the total sum of all the scores divided by the number of scores. The midpoint—the 50th percentile—is the **median**. On a divided highway, the median is the middle. So, too, with data: If you arrange all the scores in order from the highest to the lowest, half will be above the median and half will be below it.

Measures of central tendency neatly summarize data. But consider what happens to the mean when a distribution is lopsided—when it's *skewed* by a few way-out scores. With income data, for example, the mode, median, and mean often tell very different stories (**FIGURE 3.3**). This happens because a few extreme incomes bias the mean. When Elon Musk (in 2022, the worlds' richest person) sits down in a small café, its average (mean) customer instantly becomes a billionaire. But median customer wealth remains unchanged. Understanding this, you can see why, according to the 2020 U.S. Census, over 60 percent of U.S. households have "below average" income. The bottom half of earners receive much less than half of the total national income. So, most Americans make less than average (the mean). Mean and median tell different true stories. Think of it this way: Calling someone average is a mean thing.

The point to remember: Always note which measure of central tendency is reported. If it is a mean, consider whether a few atypical scores could be distorting it.

Measures of Variation

LOQ 3-3 What is the relative usefulness of the two measures of variation?

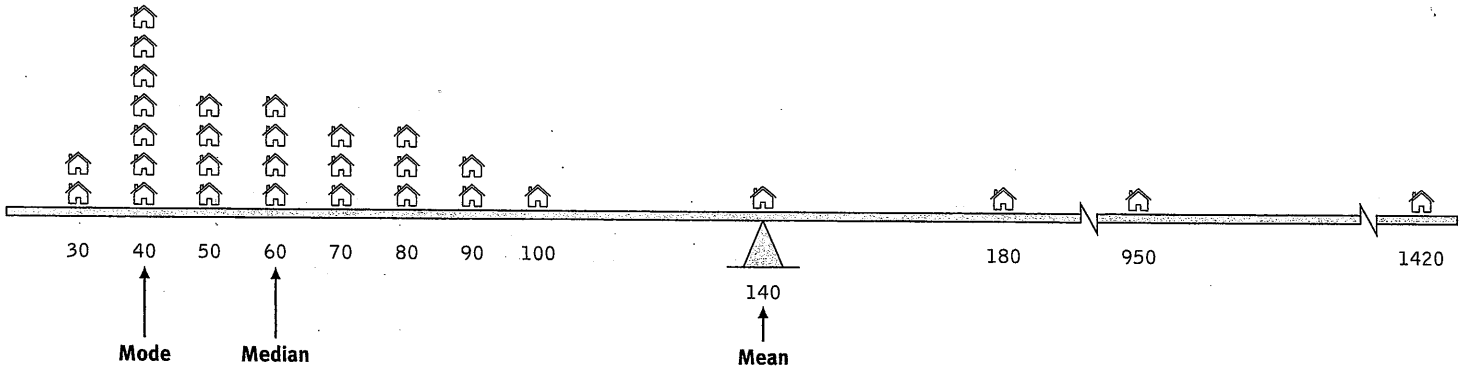
Knowing the value of an appropriate measure of central tendency can tell us a great deal. But the single number omits other information. It helps to know something about the amount of *variation* in the data—how similar or diverse the scores are. Averages derived from scores with low variability are more reliable than averages based on scores with high variability. Consider a basketball player who scored between 13 and 17 points in each of the season's first 10 games. Knowing this, we would be more confident that she would score near 15 points in her next game than if her scores had varied from 5 to 25 points.

The **range** of scores—the difference between the lowest and highest—provides only a crude estimate of variation. A couple of extreme scores in an otherwise similar group,

The average person has one ovary and one testicle.

Dave Carpenter/Cartoon Stock

FIGURE 3.3
A skewed distribution This graphic representation of the distribution of a village's incomes illustrates the three measures of central tendency: mode, median, and mean. Note how just a few high incomes make the mean—the fulcrum point that balances the incomes above and below—deceptively high.



such as the $950,000 and $1,420,000 incomes in Figure 3.3, will create a deceptively large range.

It's good to know the range of scores, but we often want to know how much scores vary in relation to a population's average. The **standard deviation** measures how much scores deviate (differ) from the mean. It better gauges whether scores are packed together or dispersed, because it uses information from each score. The standard deviation is derived from a mathematical formula[7] that assembles information about how much individual scores differ from the mean, which can be very telling. Let's say test scores from Class A and Class B both have the same mean (75 percent correct), but very different standard deviations (5.0 for Class A and 15.0 for Class B). Have you ever had test experiences like that—where two-thirds of your classmates in one course score in the 70 to 80 percent range, with scores in another course more spread out (two-thirds between 60 and 90 percent)? The standard deviation, as well as the mean score, tell us about how each class is faring.

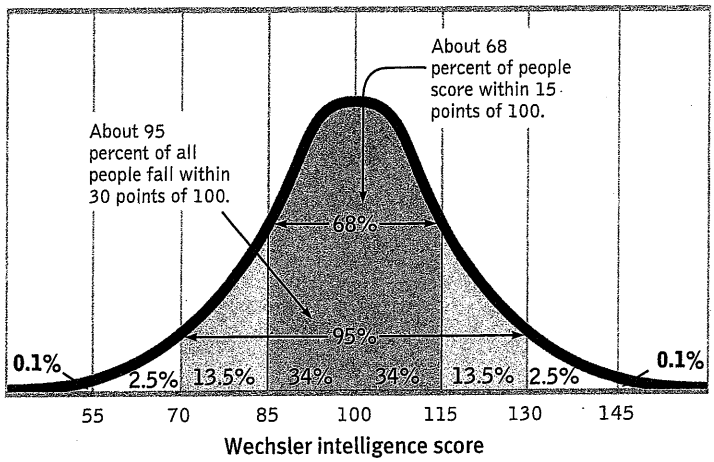


FIGURE 3.4
The normal curve Scores on aptitude tests tend to form a normal, or bell-shaped, curve. The most commonly used intelligence test, the Wechsler Adult Intelligence Scale, calls the average score 100.

You can grasp the meaning of the standard deviation if you consider how scores naturally tend to be distributed. Large numbers of data—heights, intelligence scores, life expectancy (though not incomes)—often form a symmetrical, *bell-shaped* distribution. Most cases fall near the mean, and fewer cases fall near either extreme. This bell-shaped distribution is so typical that we call the curve it forms the **normal curve**.

As FIGURE 3.4 shows, a useful property of the normal curve is that roughly 68 percent of the cases fall within one standard deviation on either side of the mean. About 95 percent of cases fall within two standard deviations. Thus, as Module 30 notes, about 68 percent of people taking an intelligence test will score within 15 points—either above or below—of 100. About 95 percent will score within ±30 points.

RETRIEVAL PRACTICE

RP-2 The average of a distribution of scores is the _____. The score that shows up most often is the _____. The score right in the middle of a distribution (half the scores above it; half below) is the _____.

RP-3 We determine how much scores vary around the average in a way that includes information about the _____ of scores (difference between highest and lowest) by using the _____ formula.

ANSWERS IN APPENDIX E

Inferential Statistics

LOQ 3-4 How do we know whether an observed difference can be generalized to other populations?

From moment to moment, people's behaviors may vary. Thus, one group's average score could conceivably differ from another group's average score not because of any real difference, but merely because of chance fluctuations in the people sampled. **Inferential statistics** use the results from a sample to inform us about a larger population (everybody in some group). When we infer that our sample's difference reflects a true population difference, we are saying the difference is **statistically significant**. When we

standard deviation a computed measure of how much scores vary around the mean score.

normal curve a symmetrical, bell-shaped curve that describes the distribution of many types of data; most scores fall near the mean (about 68 percent fall within one standard deviation of it) and fewer and fewer near the extremes. (Also called a *normal distribution*.)

inferential statistics using statistical methods to interpret data meaningfully.

statistical significance a statistical statement of how likely it is that an obtained result (such as a difference between samples) occurred by chance, assuming there is no difference between the populations being studied.

[7] The actual standard deviation formula is: $\sqrt{\frac{\text{Sum of (deviations from mean)}^2}{\text{Number of scores} - 1}}$

meta-analysis a statistical procedure for analyzing the results of multiple studies to reach an overall conclusion.

conclude that our sample's difference is likely just a fluke, we're saying it's not statistically significant. (We will focus only on this part of inferential statistics.)

Significant Differences

Imagine a prospective student who visits two similar universities. At the first school, the student randomly samples two classes and finds that both instructors are witty and engaging. At the second school, the two sampled instructors seem dull and uninspiring. Should the student conclude that the first school's teachers are "great" and the second school's teachers are "bores"? You might respond that the student should sample more classes—and you'd be right. It's possible that the populations of teachers at the two universities are equal. Just by chance, the student could have sampled two great (and two boring) teachers.

How confidently can we infer that some observed difference in a sample (such as a couple of teachers) reflects the larger population it comes from (all the teachers at the school)?

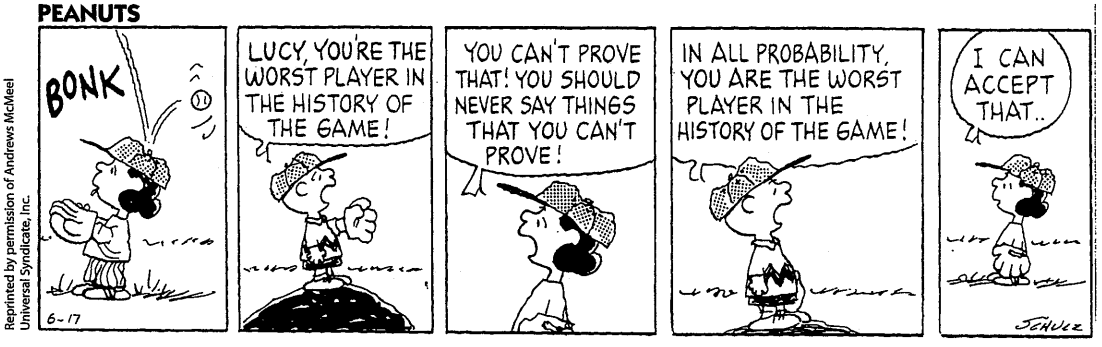
In deciding when it is safe to infer a population difference from a sample difference, we should keep three principles in mind:

1. ***Representative samples are better than biased (unrepresentative) samples.*** The best basis for generalizing is not from the exceptional and memorable cases one finds at the extremes but from a representative sample of cases. Research never randomly samples the whole human population. Thus, it pays to keep in mind what population a study has sampled.
2. ***Bigger samples are better than smaller ones.*** We know it but we ignore it: *Averages based on many cases are more reliable* than averages based on only a few. If you select a certain instructor's class based on conversations with three people, you can't conclude much. A set of 50 class evaluations will give you a better estimate of an instructor's performance. More (randomly sampled) cases make the sample's estimate more reliable. Larger samples also make for a more *replicable* study—one that will find a similar estimate the next time.
3. ***More estimates are better than fewer estimates.*** A study gives one brief peek at what's going on in the population. But the best thing to do is conduct multiple studies and combine all the estimates, using **meta-analysis**. Better to consider an entire forest of findings rather than focusing on a single study.

The point to remember: Smart thinkers are not overly impressed by a few anecdotes. Estimates based on a few unrepresentative cases are unreliable.

Let's consider another significant differences example. Say you sampled men's and women's scores on a laboratory test of aggression and found a gender difference. But samples can vary. So how likely is it that your observed gender difference was just a fluke?

Researchers use statistical testing to estimate the probability of the result occurring by chance. They begin with the assumption that no difference exists between groups,



an assumption called the *null hypothesis*. Then, using statistics, they evaluate whether the observed gender difference is so big that it's unlikely to fit the null hypothesis. If so, they reject the null hypothesis of no differences, and they say that the result is statistically significant. Such a large difference would support an *alternative hypothesis*—that the populations of men and women really do differ in aggression.

What factors determine statistical significance? When averages from two samples are each reliable measures of their respective populations (as when each is based on many observations that have low variability), then any difference between the two samples is more likely to be statistically significant. (For our example: The less the variability in women's and in men's aggression scores, and the more scores we observe, the more confidence we would have that our observed gender difference is real.) When the difference we estimate is *large*, it's also more likely to reflect a real difference in the population.

In short, when estimates are reliable and when the difference between them is relatively large, we're more likely to find that the difference is statistically significant. This means that the observed difference in the sample is probably more than just chance variation, so we reject the original null hypothesis of no existing differences.

In judging statistical significance, psychologists are conservative. They are like juries that must presume innocence until guilt is proven. Many psychological tests provide *p*-values, which indicate the probability of the result, given the null hypothesis. For most psychologists, strong evidence that we can reject the null (no-difference) hypothesis occurs when the probability (*p*-value) of that result is very low. "Very low" is usually set at less than 5 percent ($p < .05$). When a sample's result would occur less than 5 percent of the time assuming the null hypothesis, we say it is significant.

When learning about research, you should remember that a "statistically significant" result may have little *practical significance*. Especially when a sample is very large, a result might be statistically significant but have a tiny *effect* size. One large study tested the intelligence of first-born and later-born individuals. Researchers revealed a statistically significant tendency for first-born individuals to have higher average scores than their later-born siblings (Rohrer et al., 2015; Zajonc & Markus, 1975). But the difference was only about 1.5 IQ points. There were 20,000 people in the study, so this difference was "significant," but it had little practical importance.

The point to remember: Statistical significance indicates the likelihood that the result would have happened by chance if the null hypothesis (of no difference) were true. But statistically significant is not the same as *important* or *strong*.

ASK YOURSELF

Can you think of a situation where you were fooled by a writer or speaker's attempts to persuade you with statistics? What have you learned in this module that will be most helpful in the future to avoid being misled?

RETRIEVAL PRACTICE

RP-4 Can you solve this puzzle?

The registrar's office at the University of Michigan has found that usually about 100 students in Arts and Sciences have perfect marks at the end of their first term. However, only about 10 to 15 students graduate with perfect marks. What do you think is the most likely explanation for the fact that there are more perfect marks after one term than at graduation (Jepson et al., 1983)?

RP-5 _____ statistics summarize data, while _____ statistics determine if data can be generalized to other populations.

ANSWERS IN APPENDIX E

MODULE 3

REVIEW Statistical Reasoning in Everyday Life

LEARNING OBJECTIVES

Test Yourself Answer these repeated Learning Objective Questions on your own (before "showing" the answers here, or checking the answers in Appendix D) to improve your retention of the concepts (McDaniel et al., 2009, 2015).

LOQ **3-1** Why does statistical literacy matter?

LOQ **3-2** How do we describe data using three measures of central tendency?

LOQ **3-3** What is the relative usefulness of the two measures of variation?

LOQ **3-4** How do we know whether an observed difference can be generalized to other populations?

TERMS AND CONCEPTS TO REMEMBER

Test Yourself Write down the definition in your own words, then check your answer.

statistics, p. 43
descriptive statistics, p. 45
mode, p. 46
mean, p. 46
median, p. 46
range, p. 46
standard deviation, p. 47
normal curve, p. 47
inferential statistics, p. 47
statistical significance, p. 47
meta-analysis, p. 48

MODULE TEST

Test Yourself Answer the following questions on your own first, then "show" the answers here, or check your answers in Appendix E.

1. Which of the three measures of central tendency is most easily distorted by a few very high or very low scores?
   a. The mode
   b. The mean
   c. The median
   d. They are all equally vulnerable to distortion from atypical scores.

2. The standard deviation is the most useful measure of variation in a set of data because it tells us
   a. the difference between the highest and lowest scores in the set.
   b. the extent to which the sample being used deviates from the bigger population it represents.
   c. how much individual scores differ from the mode.
   d. how much individual scores differ from the mean.

3. Another name for a bell-shaped distribution, in which most scores fall near the middle and fewer scores fall at each extreme, is a _____ _____.

4. When sample averages are _____ and the difference between them is _____, we can say the difference is more likely to be statistically significant.
   a. reliable; large
   b. reliable; small
   c. due to chance; large
   d. due to chance; small