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Courtesy Fred Nighout, Duke University, North Carolina, USA.



Twinsters (2015). Small Package Films.



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Chris Maddaloni/Newscom/CQ/Roll Call/ Washington, DC, USA.

CHAPTER OUTLINE AND LEARNING OBJECTIVES

The Science of Psychology

- LO 1** Describe how psychologists use the scientific method.
- LO 2** Distinguish between a random sample and a representative sample.

Descriptive and Correlational Methods

- LO 3** Recognize several forms of descriptive research.
- LO 4** Describe the correlational method and identify its limitations.

The Experimental Method

- LO 5** Explain how the experimental method can establish cause and effect.
- LO 6** Explain why reliability and validity are important.

Analyzing the Data

- LO 7** Define and give examples of descriptive statistics.
- LO 8** Define and give examples of inferential statistics.

The Research Must Be Ethical

- LO 9** Demonstrate an understanding of research ethics.

Research
Methods

2

The Science of Psychology

PARALLEL LIVES December 15, 2012: It was a cold and rainy day in London, England. Twenty-five-year-old Anaïs Bordier was in a fabric shop, browsing materials for her upcoming fashion show. Born and raised in the suburbs of Paris, France, Anaïs had come to London to study fashion design at the prestigious arts and design college Central Saint Martins.

“Bzzzt, bzzzt!” It was Anaïs’ cell phone; one of her friends had posted an image on her Facebook wall. Anaïs caught a glimpse of the post, which appeared to be a photo of her own face, but she couldn’t figure out where it came from because the Internet connection was slow. “[For] 30–35 minutes, I couldn’t look at what was happening on my phone, and I could see people commenting on it,” Anaïs recalls. “It was driving me crazy.”

Anaïs finally got home and made a beeline for her laptop. The Facebook post generating so much buzz was a screen grab from a YouTube video—a close-up of a young woman looking over her shoulder and smiling coyly. She looked



“I Was Like Whaaaa???”

The original wall post by Anaïs’ friend shows her American look-alike in a YouTube video (left). For comparison, see the profile photo of Anaïs to the right.
Left: *Twinsters* (2015). Small Package Films. Right: Anaïs Bordier.

Note: The story of Anaïs Bordier and Samantha Futerman is based on personal communications with them, as well as the book they coauthored with Lisa Pulitzer, *Separated@Birth*, and the documentary film *Twinsters*. Unless otherwise specified, quotations attributed to Anaïs Bordier, Samantha Futerman, and Dr. Nancy L. Segal are personal communications.

Sam and Anaïs, In Their Own Words

<http://qrs.ly/2r77rvp>



Macmillan Learning.

scan this



EXACTLY like Anaïs. Heart racing, Anaïs clicked on the video link, which led to a short comedy piece called “High School Virgin” produced by an American actor popularly known as KevJumba. The woman in the video was a mirror image of Anaïs, and with the exception of her American accent, she sounded identical, too.

Anaïs felt her blood pressure drop. Could this American woman be a long-lost identical twin? Impossible. According to Anaïs’ birth records, she was a single baby born to an unwed mother in Busan, South Korea, and adopted by a French couple, Jacques and Patricia Bordier. If the American look-alike wasn’t a twin, perhaps she could be a cousin, a younger sister, a half-sister?

A couple of months (and many Internet searches) later, Anaïs and her friends discovered the mystery woman in another online video: the trailer for a major Hollywood production called *21 & Over*. Anaïs immediately searched the online list of cast members, spotted her look-alike, and clicked on her profile. The young woman’s name was Samantha Futerman, and she was born on November 19, 1987 . . . the same date as Anaïs. 📌

WHY IS PSYCHOLOGICAL RESEARCH IMPORTANT?

On a superficial level, the young actress Samantha Futerman appeared to be Anaïs’ identical twin. Her facial features, voice, and physique were virtually the same. Of course, there is much more to a person than a physical body. Anaïs wondered if her look-alike shared similar attitudes, preferences, and behaviors. Did Samantha Futerman have the same offbeat sense of humor and explosive, rolling laugh? Did she choose similar friends, and was she a glutton for fried chicken and afternoon naps? When it came to Samantha’s psychological characteristics—those related to her behavior and mental processes—Anaïs was totally in the dark.

Nature and Nurture

INSIGHTS FROM TWIN RESEARCH



Let’s suppose Sam and Anaïs are identical twins. This means that their *genes* (the units of heredity passed from parents to children) were identical at conception, making them virtually equivalent in their *nature* (Abdellaoui et al., 2015; McRae, Visscher, Montgomery, & Martin, 2015). But growing up in separate households means they have experienced distinct sets of environmental forces, making them different in their *nurture*. Any similarities observed between the two women are likely influenced by their common nature, whereas differences are presumably linked to their unique upbringing and life experiences,

or nurture. Studying identical and fraternal twins (those raised together and those raised apart) helps psychologists learn how **nature and nurture** interact to produce a variety of characteristics, from personality traits to brain function (Polderman et al., 2015; Segal, 2017). For example, researchers have found that identical twins—even those raised apart—tend to be very close on measures of personality (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990; Segal, 2012). This suggests that genes (nature) can play a major role in shaping personality traits, an idea supported by genetic research (van der Linden et al., 2018; Vukasović & Bratko, 2015).

Twin research is not just important to twins; it has implications for parents and children all over the world. Consider autism, a neurodevelopmental disorder characterized by differences in social communication and interactions. Research suggests that autism has a strong genetic component, though environment plays a role (Chapter 15; Tick, Bolton, Happé, Rutter, & Rijsdijk, 2016). Suppose one identical

**IT HAS
IMPLICATIONS
FOR PARENTS AND
CHILDREN ALL
OVER THE WORLD.**

CONNECTIONS

In **Chapter 1**, we described how early philosophers contemplated the importance of nature and nurture. Most contemporary psychologists agree that inherited biological factors (nature) and forces in the environment (nurture) interact to produce human characteristics.

twin develops autism but his twin does not. That means some factor(s) in the environment (perhaps even those present during embryonic and fetal development) could have triggered the development of the disorder (de Zeeuw, van Beijsterveldt, Hoekstra, Bartels, & Boomsma, 2017). If we can identify the triggers, which may be numerous and complex, then we can benefit from that knowledge (Segal, 1999). Studies of identical twins and fraternal twins (who, like non-twin siblings, share approximately 50% of their genes) have helped psychologists untangle the roles of nature and nurture in a variety of areas, including intelligence (Chapter 8), sexual orientation (Chapter 11), aspects of personality (Chapter 12), and psychological disorders (Chapter 15). 🌱

Now that we have touched on some of the insights gained through twin studies, let's widen our focus to psychological research in general. Time to learn about one of the most trusted approaches for acquiring knowledge: the *scientific method*.

THE SCIENTIFIC METHOD

LO1 Describe how psychologists use the scientific method.

Like all scientists, psychologists conduct research using the **scientific method**, a process for gathering empirical evidence, or data from systematic observations or experiments (INFOGRAPHIC 2.1 on the next page). This evidence is often used to support or refute a **hypothesis** (hi-POTH-uh-sis), which is a statement used to test a prediction about the outcome of a study. An **experiment** is a controlled procedure involving scientific observations and/or manipulations by the researcher to influence participants' thinking, emotions, or behaviors. Observations must be objective, or outside the influence of personal opinions and expectations. Humans are prone to errors in thinking, but the scientific method helps to minimize their impact. Let's examine the five basic steps.

STEP 1: DEVELOP A QUESTION The scientific method typically begins when a researcher observes something interesting in the environment and comes up with a research question. For example, twin researcher Dr. Nancy L. Segal got the idea for her first twin study at a child's birthday party. She noticed a pair of fraternal twins working on a puzzle together and fighting over it like mad. This led her to wonder, would identical twins cooperate better than fraternal twins? Her curiosity also stemmed from years of studying behavioral genetics and evolutionary theory—the work of scientists who had come before her. Reading books and articles written by scientists is an excellent way to generate ideas for new studies. The infographic **How to Read a Scientific Article** (on the inside front cover) explains how to find and read a journal article—skills that will help you in psychology and many other classes. It also shows you how to cite a journal article using the APA style established by the American Psychological Association (APA, 2010b).

In Class: Collaborate and Report



In your group, **A)** discuss psychological traits and processes that are influenced by genes and environment (nature and nurture). **B)** Connect to an online database through your college or public library. **C)** Search for journal articles on twin or family studies that address these phenomena. **D)** Using APA style, create a reference list including at least two of the articles your team found.



Same Species, Really?

Would you believe that these two butterflies belong to the same species? The wing markings and color differ because they were born in different seasons and therefore exposed to distinct environmental pressures (Hey, 2009).

A testament to the power of nurture. Courtesy Fred Nighout, Duke University, North Carolina, USA.

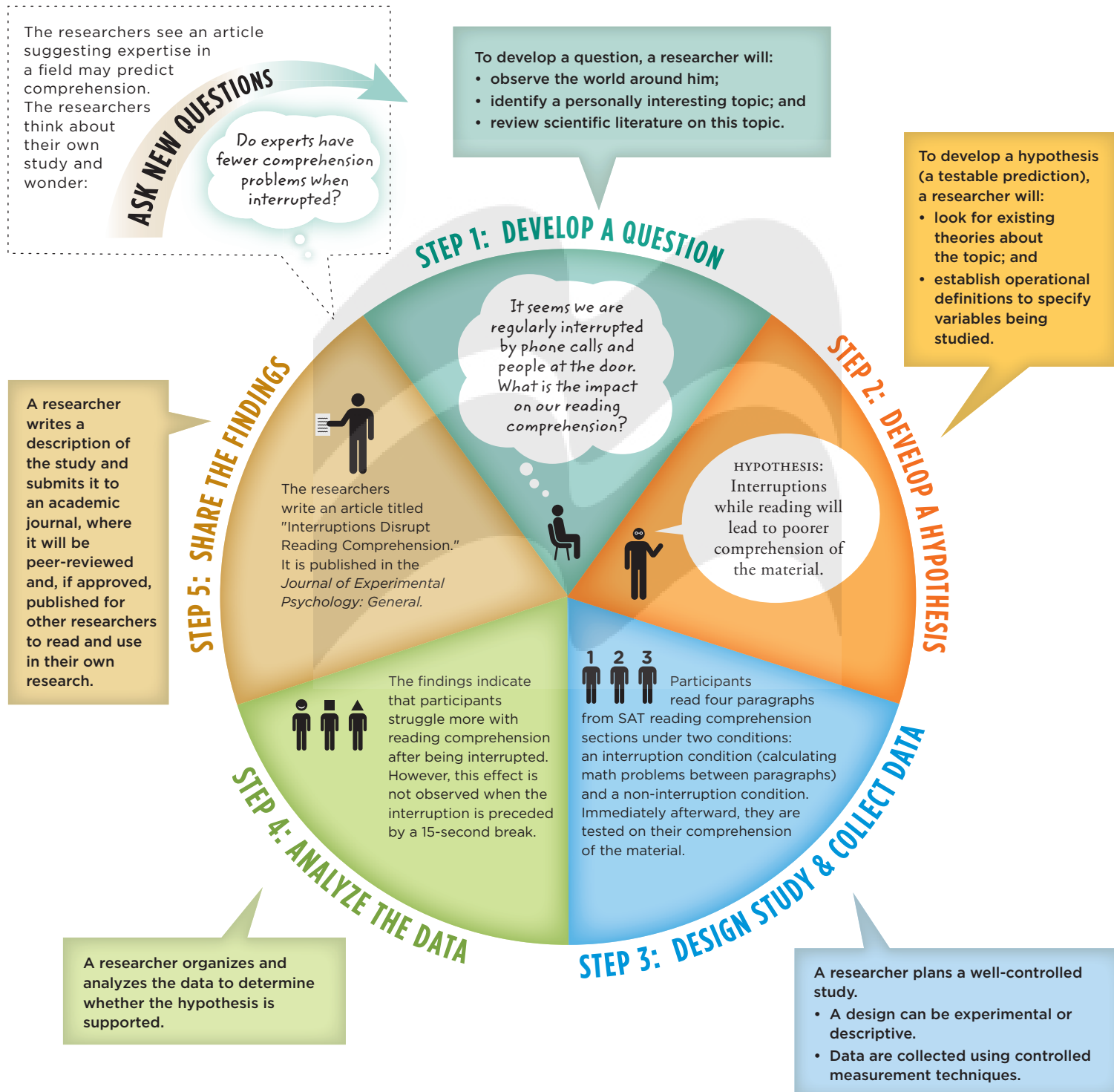
scientific method The process scientists use to conduct research, which includes a continuing cycle of exploration, critical thinking, and systematic observation.

hypothesis A statement that can be used to test a prediction.

experiment A controlled procedure that involves careful examination through the use of scientific observation and/or manipulation of variables (measurable characteristics).

The Scientific Method

Psychologists use the scientific method to conduct research. The scientific method allows researchers to collect empirical (objective) evidence by following a sequence of carefully executed steps. In this infographic, you can trace the steps of an actual research project performed by psychologists who were interested in the effect of interruptions on reading comprehension (Foroughi, Werner, Barragán, & Boehm-Davis, 2015). Notice that the process is cyclical in nature. Answering one research question often leads researchers to develop additional questions, and the process begins again.



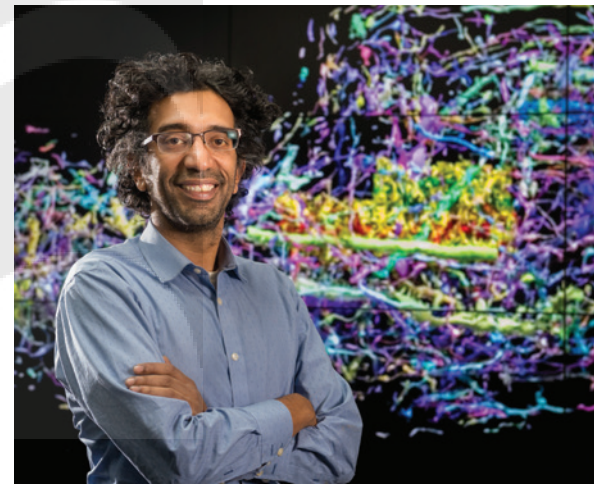
STEP 2: DEVELOP A HYPOTHESIS Once a research question has been developed, the next step is to formulate a hypothesis, the statement used to test predictions about a study's outcome. The data collected by the experimenter will either support or refute the hypothesis. Dr. Segal's hypothesis was essentially the following: *When given a joint task, identical twins will cooperate more and compete less than fraternal twins.* Hypotheses can be difficult to generate for studies on new and unexplored topics, because researchers may not have fully developed expectations for the outcome; in these situations, a general prediction may take the place of a formal hypothesis. Researchers cannot just guess when they develop their hypotheses. They must carefully review research and consider relevant psychological perspectives. What perspective do you think influenced Dr. Segal's hypothesis?

While developing research questions and hypotheses, researchers should always be on the lookout for information that could offer explanations for the phenomenon they are studying. Dr. Segal based her hypothesis on behavioral genetics and evolutionary theory. A **theory** synthesizes observations in order to explain phenomena, and it can be used to make predictions that can be tested through research. Many people believe scientific theories are nothing more than unverified guesses, but they are mistaken (Stanovich, 2019). A theory is a well-established body of principles that often rests on a sturdy foundation of scientific evidence. Evolution is a prime example of a theory that has been mistaken for an ongoing scientific controversy. Thanks to inaccurate portrayals in the media, frequently involving opinions by non-scientists, many people believe evolution is an active area of "debate." In reality, evolution is a theory supported by the overwhelming majority of scientists, including psychologists.

STEP 3: DESIGN STUDY AND COLLECT DATA Once a hypothesis has been developed, the researcher designs a study to test it and then collects the data. Dr. Segal's study involved videotaping sets of identical and fraternal twin children working together on a puzzle. Once the instructions were given ("Complete the puzzle together"), the pairs of twin children were free to solve the puzzle as they wished (Segal, 1984, p. 94). Later, looking at the videos, Dr. Segal and her colleagues rated the twins using a variety of "indices of cooperative behavior." For example, the researchers observed if the twins were equally involved, how often they handed each other puzzle pieces, whether they physically leaned on one another, pushed, or hit. They even tallied up the number of facial expressions each twin displayed (for example, sadness, surprise, and pride).

To study cooperative behavior and other characteristics, researchers must establish **operational definitions** that specify the precise manner in which they are defined and measured. Operational definitions are different from dictionary definitions, which tend to be very similar across dictionaries. For example, there are probably only a handful of ways that dictionaries define the word "cooperation." But because constructs like cooperation can be measured in a variety of ways, researchers need to establish objective, precise definitions for them. A good operational definition helps others understand how to perform an observation or take a measurement. In the example above, Dr. Segal operationally defined cooperative behavior based on how often twins worked together, accepted each other's help, or smiled at each other. If you were studying intoxication in college students, your operational definition of "drunkenness" might be based on a physiological measure, such as a blood alcohol level (BAC) of 0.8 or higher. What problems would result if researchers didn't operationally define the characteristics they are measuring?

Gathering data must be done in a very controlled fashion to minimize errors, which could arise from recording problems or from unknown environmental factors. Suppose a researcher is studying how identical twins react to frustrating situations.



So Much Data

Neuroscientist Narayanan "Bobby" Kasthuri of Argonne National Laboratory is trying to create a complete 3-D map of the human brain, one that shows all 100 billion neurons—and the quadrillions of connections between them! If Kasthuri and his colleagues manage to collect all the data needed to generate such a map, they may end up dealing with the biggest data set scientists have ever confronted (Mitchum, 2018, July 19). Argonne National Laboratory.

theory Synthesizes observations in order to explain phenomena and guide predictions to be tested through research.

operational definitions The precise manner in which variables of interest are defined and measured.

Variable	Record Number	Columns	Format
FAMILYID	1	3–7	Numeric
FROMWHO	1	9–12	Numeric
WHICHATT	1	14–17	Numeric
INT_T_	1	19–24	Numeric
INT_S_	1	26–31	Numeric
CON_T_	1	33–38	Numeric
CON_S_	1	40–46	Numeric
PERS	1	48–52	Numeric
GLOB	1	54–58	Numeric
STA_C_	1	60–64	Numeric
STA_O_	1	66–70	Numeric
BARR	1	72–76	Numeric
BREW	2	1–5	Numeric

FIGURE 2.1

Raw Data

The information in this figure comes from a data file. Until the researcher analyzes the data, these numbers will have little meaning.

He could collect information by talking with them for several hours, but his impressions may differ from those of another researcher facing the same task. To reduce bias, interviewers should follow a consistent questioning format, or coding scheme, and make sure to employ operational definitions. An even more objective approach would be to administer an assessment with a standard set of questions (true/false, multiple choice, circle the number) and an automated scoring system. The results of such a test do not depend on the researchers’ biases or expectations, and should be the same no matter who administers it.

STEP 4: ANALYZE THE DATA Now that the data are collected, they need to be analyzed, or organized in a meaningful way. As **FIGURE 2.1** demonstrates, rows and columns of numbers are just that, numbers. In order to make sense of all the “raw” data, one must employ statistical methods. *Descriptive statistics* are used to organize and present data, often through tables, graphs, and charts. *Inferential statistics*, on the other hand, go beyond simply describing the data set, allowing researchers to make inferences and determine the probability of events occurring in the future. (We take a closer look at descriptive and inferential statistics later in the chapter and in Appendix A.)

Following the data analysis, the researcher must ask several questions: Did the results support the hypothesis? Were the predictions met? In Dr. Segal’s case, the results did support her hypothesis: “The identical twins were more cooperative on almost every index that I used,” she says. “My conclusion was that yes, identical genes do contribute to the greater cooperation observed between partners.” Even if results support a hypothesis, the researcher will re-evaluate her hypotheses in light of the findings. For example, she might ask herself if the results are consistent with previous studies, or whether they increase support for a particular theory.

STEP 5: SHARE THE FINDINGS Once the data have been analyzed and the hypothesis tested, it’s time to share the findings with other researchers who might be able to build on the work. This typically involves conference presentations, online discussions, and written documentation. One of the best ways to disseminate information is to write a scientific article and submit it to a scholarly, peer-reviewed journal. Journal editors send these submitted manuscripts to subject-matter experts, or peer reviewers, who carefully read them and make recommendations for publishing, revising, or rejecting the articles altogether.

The peer-review process is notoriously meticulous, and it helps provide us with more certainty that research findings can be trusted. When looking for research to support your presentations or papers, try to use a search engine that allows you to narrow your search to studies that have been peer-reviewed. Although the Internet is an amazing tool for gathering information, a search engine like Google Scholar casts a wide net, and some of the articles it lists are of questionable origin and **quality**.

Unfortunately, the peer-review method is not flawless. For example, editorial boards may show favoritism toward certain authors. One study found that articles are more likely to be accepted by prestigious journals when the authors have already published work there (Callier, 2018, December 10; Sekara et al., 2018). What’s more, there have been cases of fabricated data slipping past the scrutiny of peer reviewers. About 4 in 10,000 published articles end up being retracted, the result of not only errors but also plagiarism, data meddling, and other forms of inappropriate behavior (Brainard & You, 2018, October 26). Such misconduct can have serious consequences for society. Case in point: the spread of misinformation about the safety of childhood vaccines, which has stirred a movement among a small subset of U.S. parents. In the late 1990s, researchers published a study suggesting that vaccination against infectious diseases caused autism (Wakefield et al., 1998). The findings

CONNECTIONS

In **Chapter 1**, we discussed the importance of considering the source and quality of information before accepting it as valid. This is an important component of critical thinking. *Connections* like this are scattered throughout the textbook, helping you see the relationships between topics discussed in the current chapter and those presented in earlier ones.

sparked panic among parents, some of whom shunned the shots, putting their children at risk for life-threatening infections such as measles. The study turned out to be fraudulent and the reported findings were deceptive, but it took 12 years for journal editors to retract the article (Editors of *The Lancet*, 2010). One reason for this long delay was that researchers had to investigate all the accusations of wrongdoing and data fabrication (Godlee, Smith, & Marcovitch, 2011). The investigation included interviews with the parents of the children discussed in the study, which ultimately led to the conclusion that the information in the published account was inaccurate (Deer, 2011).

Since the publication of that deceptive research, several high-quality studies have found no credible support for the autism–vaccine hypothesis (Honda, Shimizu, & Rutter, 2005; Jain et al., 2015; Madsen et al., 2002). Still, the publicity given to the original article continues to cast a shadow: Some parents refuse vaccines for their children, with serious consequences for the community. Measles outbreaks involving unvaccinated people have occurred in various parts of the United States in recent years, putting those affected at risk for death and lasting disabilities (Chen, 2014, June 26; Romo & Neighmond, 2019, January 28).

Publishing an article is a crucial step in the scientific process because it allows other researchers to **replicate** an experiment, which might mean repeating it with other participants or altering some of the procedures. This repetition is necessary to ensure that the initial findings were not just a fluke or the result of a poorly designed experiment. The more a study is replicated and produces similar findings, the more confidence we can have in those findings.

In the case of Wakefield's fraudulent autism study, other researchers tried to replicate the research for over 10 years, but could never establish a relationship between autism and vaccines (Godlee et al., 2011). This fact alone made the Wakefield findings highly suspect.

ASK NEW QUESTIONS Although the goal is to increase our knowledge, most studies generate more questions than they answer, and here lies the beauty of the scientific process. The results of one scientific study raise a host of new questions, and those questions lead to new hypotheses, new studies, and yet another collection of questions. New results also prompt researchers to rethink theories, as even the most established theories can be scrutinized and re-explored. You can see the cyclical nature of the scientific method illustrated in Infographic 2.1.

THINK CRITICALLY This continuing cycle of exploration uses critical thinking at every step. *Critical thinking* is the process of weighing various pieces of evidence, synthesizing them, and evaluating the contributions of each; it is a type of thinking that is disciplined, clear, rational, and open to the consideration of new ideas. For a review of critical thinking, revisit Chapter 1 (pp. 7–9) and see Infographic 1.2.

RESEARCH BASICS

CONNECTION ESTABLISHED February 21, 2013: Samantha Futerman was in Los Angeles getting ready for the red-carpet premiere of *21 & Over*. A Twitter notification appeared on her phone: “Hey Sam, my friend Anaïs sent you a message on FB, check it out 😊 (it might be in the spam box)” (Bordier, Futerman, & Pulitzer, 2014, p. 17). Sam did not recognize the sender of this message, nor did she know anyone named Anaïs. She opened Facebook and found a friend request from Anaïs Bordier, a 25-year-old woman living in London whose face



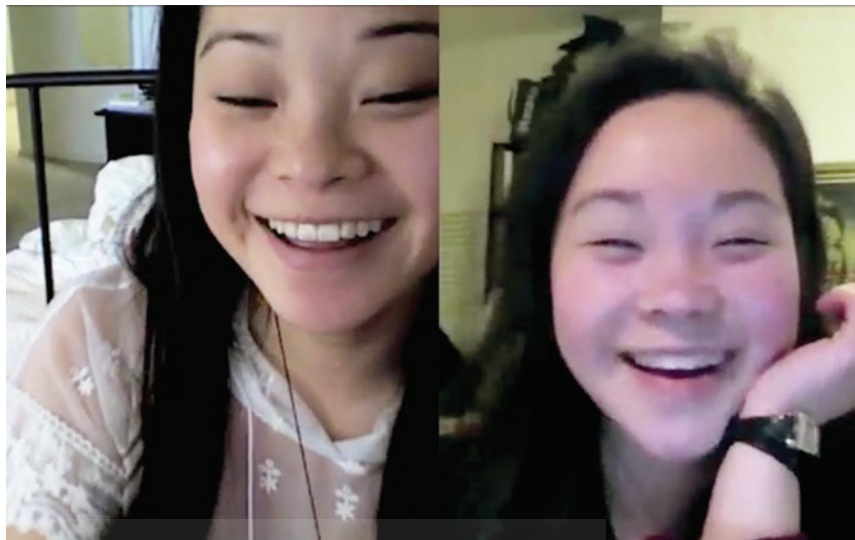
Misguided Marchers?

Parents and their children gather to protest the use of mercury-containing vaccines. Childhood vaccinations do carry the risk of mild side effects and serious (though very unusual) allergic reactions, but studies have repeatedly shown no link exists between vaccines and autism (CDC, 2018, January 29). Some of the confusion may derive from Twitter “bots” or “content polluters” that distribute anti-vaccine propaganda (Broniatowski et al., 2018). Chris Maddaloni/Newscom/CQ/Roll Call/Washington, DC, USA.

replicate To repeat an experiment, generally with a new sample and/or other changes to the procedures, the goal of which is to provide further support for the findings of the first study.

Love at First Skype

Six days after making contact on Facebook, Sam (left) and Anaïs had their first face-to-face conversation on Skype. They began at about 12:30 A.M. Paris time and continued until almost 4:00 A.M. “Speaking to Anaïs on Skype was unreal. I mean we had to be twins,” Sam recalls in the book she coauthored with Anaïs, *Separated@Birth* (Bordier et al., 2014, p. 102). “There was no reason to be scared anymore,” Anaïs writes. “Even though I didn’t have absolute proof, I had found my sister” (p. 100). *Twinsters* (2015). Small Package Films.



appeared to be an exact duplicate of her own. A knot tightening in her stomach, Sam accepted Anaïs’ friend request and opened up her message:

Hey, my name is Anaïs, I am French and live in London. About 2 months ago, my friend was watching one of your videos with KevJumba on YouTube, and he saw you and thought we looked really similar . . . like VERY REALLY SIMILAR. . . . I checked more of your videos (which are hilarious) and then came upon the “how it feels to be adopted” . . . and discovered you were adopted too. (Bordier et al., 2014, p. 13)

Sam stared at her phone, mystified. Anaïs Bordier, a complete stranger living halfway around the world, had begun to dismantle her life story with a single Facebook message. According to Sam’s papers, she was a single baby born to a mother in Busan, South Korea, and adopted a few months later by Judd and Jackie Futerman of New Jersey.

Scouring Anaïs’ Facebook photos, Sam discovered more parallels: Anaïs had freckles on her nose (uncommon among Koreans); she wore the same kind of goofy animal costumes for Halloween; and comments from friends hinted that she had some of the same personality quirks. The physical resemblance was breathtaking. “I thought she could be my reflection in a mirror,” Sam recalls. “It was beyond comprehension” (Bordier et al., 2014, p. 32).

It would take three months for Sam and Anaïs to finally meet in person, but thanks to Facebook, Skype, and WhatsApp, they would already be extremely close. Communicating daily, Sam and Anaïs began to uncover a mountain of shared characteristics—more evidence that they were twins. To capture their extraordinary story and share it with others, they decided to create a documentary film called *Twinsters* (“twin” + “sisters”). Sam would take on the role of producer, and her trusted friends and colleagues from the film industry would make up the rest of the film crew. To raise money, they posted a proposal on the funding platform Kickstarter, which caught the attention of twin expert Dr. Nancy L. Segal (introduced on p. 27). Dr. Segal immediately wondered if Sam and Anaïs had taken a DNA test to prove they were identical twins. Even though they had the same birthdates and shared many physical characteristics and behaviors, there was still the remote possibility that they were unrelated look-alikes. Dr. Segal had seen similar cases end in profound disappointment. As she puts it, “You need the biological proof.”



Proof Is in the DNA

Sam (left) and Anaïs on Skype, collecting DNA samples with cheek swabs. DNA (deoxyribonucleic acid) is the genetic material we inherit from our parents, and identical twins have almost the same DNA sequences (“almost” because, although identical twins have duplicate DNA at conception, small genetic changes can occur throughout life). After collecting the samples, Sam and Anaïs sent them to a laboratory, and the results of the analysis confirmed that they are indeed identical twins! *Twinsters* (2015). Small Package Films.

Dr. Segal reached out to Sam and Anaïs, who agreed to participate in research. They took DNA tests, which affirmed what they already knew in their hearts . . . they were indeed identical twins! Sam and Anaïs also underwent a variety of tests organized by Dr. Segal and her colleagues at California State University, Fullerton. These tests focused on physical characteristics such as height, weight, and hand preference, and psychological factors like job satisfaction, self-esteem, personality traits, and cognitive abilities—all *variables* commonly studied by psychologists. [🔗](#)

VARIABLES Measurable characteristics that can vary, or change, over time or across individuals are called **variables**. In psychological experiments, researchers study a variety of characteristics relating to humans and other organisms. Examples of variables include personality characteristics (shyness or friendliness), cognitive characteristics (memory), number of siblings in a family, gender, and socioeconomic status.

Often researchers are interested in exploring relationships between variables. In many experiments, the goal is to see how changing one variable affects another. For example, a researcher might be interested in learning whether mindfulness interventions impact body weight and eating styles: Can focusing on the process of eating make mealtimes more relaxing and help people adopt healthier diets? Researchers have studied this topic, and there does seem to be a link (Schnepper, Richard, Wilhelm, & Blechert, 2019). Once the variables for a study are chosen, researchers must create operational definitions with precise descriptions and methods of measurement.

The study of Sam and Anaïs revealed “striking similarities” across a variety of variables, including measures of job satisfaction, and certain mental abilities and personality traits. It also unearthed fascinating differences; for example, Anaïs scored higher on most of the tests measuring visual-spatial skills—not a surprise to Dr. Segal and her colleague Franchesca Cortez, who say this finding is “consistent with the idea that fashion designers benefit from good visual skills” (Segal & Cortez, 2014, p. 103). Meanwhile, Sam did better on some tests measuring memory, which could be a result of her experience memorizing lines for acting roles and waiting tables (Segal & Cortez, 2014). “It really would stress me out,” says Sam, recalling her days running between tables. “I would have nightmares . . . I would wake up and be like, ‘I didn’t bring his ketchup!’”

You Asked, Sam and Anaïs Answer

<http://qrs.ly/2r77rvp>

What is the best part about having an identical twin?

scan this



LO2 Distinguish between a random sample and a representative sample.

POPULATION AND SAMPLE The findings described above focus on just two individuals—Sam and Anaïs. How do researchers decide who should participate in their studies? It depends on the **population**, or overall group the researcher wants to examine. If the population is large (all college students in the United States, for example), then the researcher selects a subset of that population called a **sample**.

There are many methods for choosing a sample. In an effort to ensure that the sample accurately reflects the larger population, a researcher may use a **random sample**. With a random sample, all members of the population have an equal chance of being invited to participate in the study. A researcher forming a random sample of high school seniors might try to gain access to SAT or ACT databases and then randomly select students from lists compiled by those test companies.

Think about the problems that may crop up if a sample is not random. Suppose a researcher is trying to assess attitudes about undocumented workers living in the United States, but the only place she recruits participants is New York City, which (along with Los Angeles, California) has the biggest population of undocumented

variables Measurable characteristics that can vary over time or across people.

population All members of an identified group about which a researcher is interested.

sample A subset of a population chosen for inclusion in an experiment.

random sample A subset of the population chosen through a procedure that ensures all members of the population have an equal chance of being selected to participate in the study.

immigrants (Passel & Cohn, 2019, March 11). How might this bias her findings? A study of people in New York would certainly offer valuable insights about residents of that city, but it would not necessarily provide a complete picture of attitudes across the United States. New York residents do not constitute a **representative sample**, or group of people with characteristics similar to those of the population of interest (in this case, the entire U.S. population).

It is important for researchers to choose representative samples, because this allows them to generalize their findings, or apply information from a sample to the population at large. Let's say that 44% of the respondents in the study on attitudes toward undocumented workers believe current immigration laws are acceptable. If the sample is sufficiently similar to the overall U.S. population, then the researcher may be able to infer that this finding from the sample is representative: "Approximately 44% of people in the United States believe that current immigration laws are acceptable."

In Class: Collaborate and Report



In your group, answer the following questions: **A)** What is the difference between a representative sample and a random sample? **B)** Why is it so important to have a representative sample? **C)** What can happen if a sample is not representative? **D)** If a researcher is studying attitudes about undocumented workers, what characteristics should she consider if she wants to put together a sample that is representative of the larger population?

The topics we have explored thus far—the scientific method, variables, operational definitions, and samples—apply to psychology research in general. You will see how these concepts are relevant to studies presented in the upcoming sections when we explore three major categories of research methods: descriptive, correlational, and experimental.

SHOW WHAT YOU KNOW

1. A research group is interested in studying college students' attitudes about the legalization of marijuana. The group randomly selects students from across the nation, trying to pick a _____ that closely reflects the characteristics of American college students.
 - a. variable
 - b. hypothesis
 - c. representative sample
 - d. representative population
2. The scientific method is a process for gathering empirical evidence. This evidence is often used to support or refute a(n) _____, a statement that tests a prediction about the outcome of a study.
3. Why might it be problematic to make inferences from small samples to large populations?

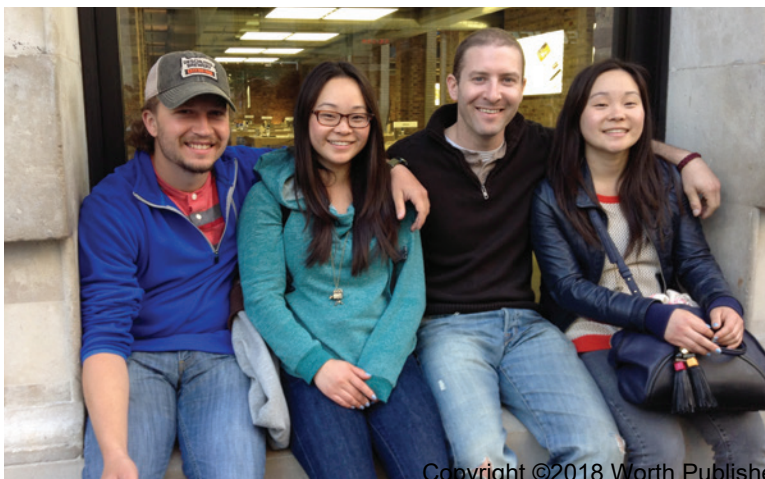
✓ CHECK YOUR ANSWERS IN APPENDIX C.

Power of Nurture

(left to right) Sam's brother Andrew, Sam, Sam's brother Matt, and Anaïs. Personality assessments suggest that Sam is more extroverted than her twin sister (Segal & Cortez, 2014). Is this because Sam grew up with two older brothers, while Anaïs was an only child? Small Package Films.

Descriptive and Correlational Methods

Sam and Anaïs share many attributes, but they are not exact copies of one another. Obvious physical differences include height (Anaïs is a bit taller) and skin color (Sam is tanner from surfing in the California sun). As for psychological disparities, the twins seem to differ in their experience of emotional stress. "Depending on what it is, I can just shake it off, but it will kind of live with [Anaïs] a little bit more," says Sam, who attributes this coping style to her experience growing up with two older brothers. When Sam felt stressed or upset, her brothers would often tell her to "get over it" and find something to do. Anaïs was an only child, so she did not "benefit" from this type of sibling interaction. Given that these women started life genetically identical, you begin to wonder about the sources of their differences. When did these disparities emerge, and what environmental factors (apart from tough older brothers) shaped them? It would be fascinating to travel back in time and observe Sam and Anaïs as little girls



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playing with friends, interacting with family, and studying at school. If only time travel were possible, there would be endless opportunities for a psychologist to use *descriptive research methods* to study their differing childhoods.

Descriptive research is a type of investigation psychologists use to explore a phenomenon. It is primarily concerned with describing, and is useful for studying new or unexplored topics when researchers might not have specific expectations about outcomes. But there are certain things descriptive research cannot achieve. This approach helps us develop hypotheses about the causes of behaviors, yet it *cannot* reveal cause-and-effect relationships, a point we will revisit later in the chapter. But first, let's explore several descriptive research methods.

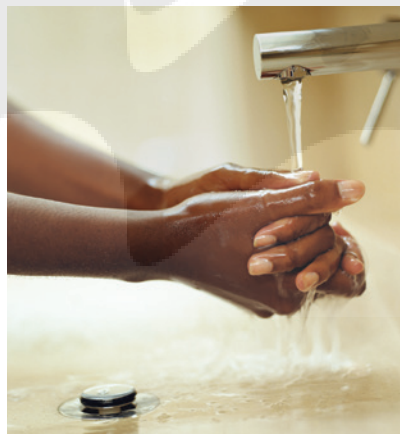
LO3 Recognize several forms of descriptive research.

NATURALISTIC OBSERVATION

Naturalistic observation refers to the systematic observation of participants in their natural environments. And when we say “natural environments,” we don't necessarily mean the “wild.” It could be an office, a preschool, or even a dorm room. In one naturalistic study, researchers observed the behaviors of Starbucks patrons in cities across China and Hong Kong. The goal was to determine if people from different regions have distinct preferences for being physically close to others. Here's what the researchers observed: People in regions with a history of wheat-growing (where farmers work more independently) were more likely to sit alone. Meanwhile, those from areas with a tradition of rice-growing (where farmers often work together) were more inclined to sit with others. In this naturalistic study, we see how **culture** may play a role in shaping everyday behavior (Talhelm, Zhang, & Oishi, 2018).

NATURALLY, IT'S A CHALLENGE As with any type of research, naturalistic observation centers around variables, and those variables must be pinned down with operational definitions. Let's say a researcher is interested in studying conscientiousness among toddlers. This is an intriguing topic, as research suggests that aspects of conscientiousness, such as self-control and compliance with parents, can present themselves early in life (Kim & Kochanska, 2019). At the beginning of the study, the researcher would need to create an operational definition for conscientiousness, which would include detailed descriptions of specific behaviors that illustrate it. Then she might create a checklist of conscientious behaviors, such as waiting to eat a snack, choosing only one prize from a toy box, and whispering when asked to do so, and a coding system to help keep track of them.

Naturalistic observation allows psychologists to observe participants going about their business in their normal environments, without the disruptions of artificial laboratory settings. Perhaps the most important requirement of naturalistic observation is that researchers must not disturb the participants or their environment. That way, participants won't change their normal behaviors, particularly those that the researchers wish to observe. Some problems arise with this arrangement, however. Natural environments may contain variables that the researchers are not interested in studying, but removing them can disrupt the natural setting they are striving to



You Asked, Sam and Anaïs Answer

<http://qrs.ly/2r77rvp>

Do you have similar boyfriends?

scan this



CONNECTIONS

We should point out that many psychological studies center on participants from Western, educated, industrialized, rich, and democratic countries (aka “WEIRD” cultures), which are not always representative of people from other cultures. In **Chapter 1**, we introduced cross-cultural research, which is beginning to address this longstanding problem.

Please Wash Your Hands

Studies suggest that women are more conscientious than men about washing their hands in restrooms (Humphreys, Fitzpatrick, & Harvey, 2015). In one naturalistic observation study, researchers sat quietly inside bathroom stalls on a university campus, using stopwatches to measure how long people spent using the facilities (as determined by the flushing sounds of toilets and urinals) and washing their hands. They found that most men and women washed their hands after using the toilet, but almost half of the men failed to clean their hands after using urinals (Berry, Mitteer, & Fournier, 2015). Do you think more men would have washed their hands if they knew they were being observed? Jutta Klee/Getty Images.

representative sample A subgroup of a population selected so that its members have characteristics similar to those of the population of interest.

descriptive research Research methods that describe and explore behaviors, but with findings that cannot definitively state cause-and-effect relationships.

naturalistic observation A type of descriptive research that studies participants in their natural environment through systematic observation.

maintain. And because the variables in natural environments are so difficult to control, researchers may have trouble replicating findings. Suppose the researcher opted to study the behavior of toddlers playing with LEGOs at day care. In this natural setting, she would not be able to control who played and when; whoever showed up at the LEGO table would become a participant in her study.

OBSERVER BIAS How can we be sure observers will do a good job recording behaviors? A researcher who has never been around toddlers might pay attention to very different aspects of play behaviors than a researcher who has six children of his own. One way to avoid such problems is to include multiple observers and then determine how similarly they record the behaviors. If the observers don't execute this task in the same way, **observer bias** may exist. This refers to errors introduced as a result of an observer's value system, expectations, attitudes, and the like.

CASE STUDY

Another descriptive research method is the **case study**, a detailed examination of an individual or small group. Case studies typically involve collecting a vast amount of data, often using multiple avenues to gather information. The process might include in-depth interviews with the person being studied and her friends, family, and coworkers, and questionnaires about medical history, career, and mental health. The goal of a case study is to provide a wealth of information from a variety of resources. Case studies are invaluable for studying rare events, like the reunion of identical twins born in South Korea and reared on different continents. They may offer valuable information we can't get anywhere else. This research method also helps guide the design of studies on relatively underexplored topics (Stanovich, 2019), such as the health and behavior of an astronaut on a space mission compared to his identical twin back on Earth (Garrett-Bakelman et al., 2019). Unlike naturalistic observation, where the researcher assumes the role of detached spectator, the case study may require immersion in the participant's environment. How do you think this might impact the researcher's observations and the conclusions of the study?

One of the most fascinating case studies in the history of twin research is that of the "Jim Twins." Identical twins Jim Springer and Jim Lewis were separated shortly after birth and reunited at age 39. When the Jims finally met, they discovered some jaw-dropping similarities: Both were named "James" by their adoptive parents and gravitated toward math and carpentry as kids. Each man had a dog named "Toy," a first wife named "Linda," and a second wife named "Betty." They even smoked the same cigarettes (Salems), drove the same type of blue Chevy, and traveled to the same vacation spot in Florida (Leo, 1987, January 12; Rawson, 1979, May 7; Segal, 2012). For examples of famous case studies in psychology, see TABLE 2.1.

No matter how colorful or thought-provoking a case study may be, it cannot provide definitive support for a hypothesis (Stanovich, 2019). Hypothesis testing involves evaluating different conditions, and because the subject of a case study represents a sample of one (consisting of an individual or a single group), comparisons are impossible. Like other types of descriptive research, this method is useful for furthering the development of theories, but it cannot identify the causes of behaviors and events.

Case studies are very specific examples, so they should not be used to make generalizations. Suppose you are trying to examine how parent-child interactions at home might relate to preschoolers' transitions during morning drop-off. What would happen if you limited your research to a case study of a family with two working parents and 10 children? The dynamics of this family may not be representative of



So Many Twins!

Every year, twins, triplets, and other multiples from around the world gather in Twinsburg, Ohio, for the Twins Days Festival. In addition to participating in talent shows, watching fireworks, and marching in the "Double Take Parade," attendees have the opportunity to meet the many scientists who flock to the festival in search of study participants (Dawidziak, 2018, August 4; Richards, 2018, September 29). Dustin Franz/Barcroft USA via Getty Images.

observer bias Errors in the recording of observations as the result of a researcher's value system, expectations, or attitudes.

case study A type of descriptive research that closely examines an individual or small group.

TABLE 2.1 Classic Case Studies in Psychology

Case Study	Description	Outcome
Phineas Gage	A railroad worker who survived after an iron rod blasted through his skull	Suggested that the frontal lobes play a role in personality
H.M.	A man who suffered from profound memory loss following brain surgery	Showed how brain damage can be linked to memory loss
Little Albert	An 11-month-old who was conditioned to fear rats	Revealed the ability to classically condition fear in humans
The Genain Quadruplets	Identical quadruplet sisters who all developed schizophrenia	Demonstrated that genetic factors are involved in schizophrenia
“Rat Man”	A man with obsessive thoughts, including a punishment involving rats	Exemplified a case study on which Sigmund Freud based his theories
Lorenz’s Geese	Goslings that became attached to Konrad Lorenz	Documented the imprinting phenomenon

Summarized here are some of the most colorful case studies in the history of psychology. These classic case studies have provided psychologists with valuable insights into human behaviors, and you will read about many of them in the chapters to come.

those in other families. We should not make sweeping generalizations based on our observations of a single person or group.

SURVEY METHOD

One of the fastest ways to collect data is the **survey method**, which relies on questionnaires or interviews. A survey is basically a series of questions that can be administered on paper, in face-to-face interviews, or via smartphone, tablet, and other digital devices. Your college might send out surveys to gauge student attitudes about new online classes and e-books (using questions such as, “How often do you encounter technical difficulties with your online courses?” or “How would you rate your overall satisfaction with the assigned e-book?”). The benefit of the survey method is that you can gather data from numerous people in a short period of time. Surveys can be used alone or in conjunction with other research methods.

WORDING AND HONESTY Like any research design, the survey method has its limitations. The wording of survey questions can lead to biases in responses. For an example, see **FIGURE 2.2** on the next page. A question with a positive or negative spin may sway a participant’s response one way or the other: Do you prefer a half-full glass of soda or a half-empty glass of soda?

More importantly, participants are not always forthright in their responses, particularly when the survey touches on sensitive issues. In short, people lie. In one study, male and female college students were asked questions about cheating in relationships. When participants were led to believe their responses were being analyzed by a lie detector, men and women were equally likely to admit to cheating behaviors. But when they believed their self-reports were anonymous, the men were more likely to confess than the women (Fisher & Brunell, 2014). Researchers in the field recommend collecting information anonymously if possible, noting the irony that infidelity “is rooted in deceit and thus inimical [contrary] to the truth that science seeks to illuminate” (Fincham & May, 2017, p. 73).

People often try to present themselves in a “favorable light” when filling out surveys, providing socially acceptable responses (Tracey, 2016). Sometimes it’s difficult to determine if this tendency toward *social desirability* has influenced their self-reports related to attitudes or behaviors that are embarrassing or deal with delicate topics (Moshagen, Hilbig, Erdfelder, & Moritz, 2014; Tourangeau & Yan, 2007). This

survey method A type of descriptive research that uses questionnaires or interviews to gather data.

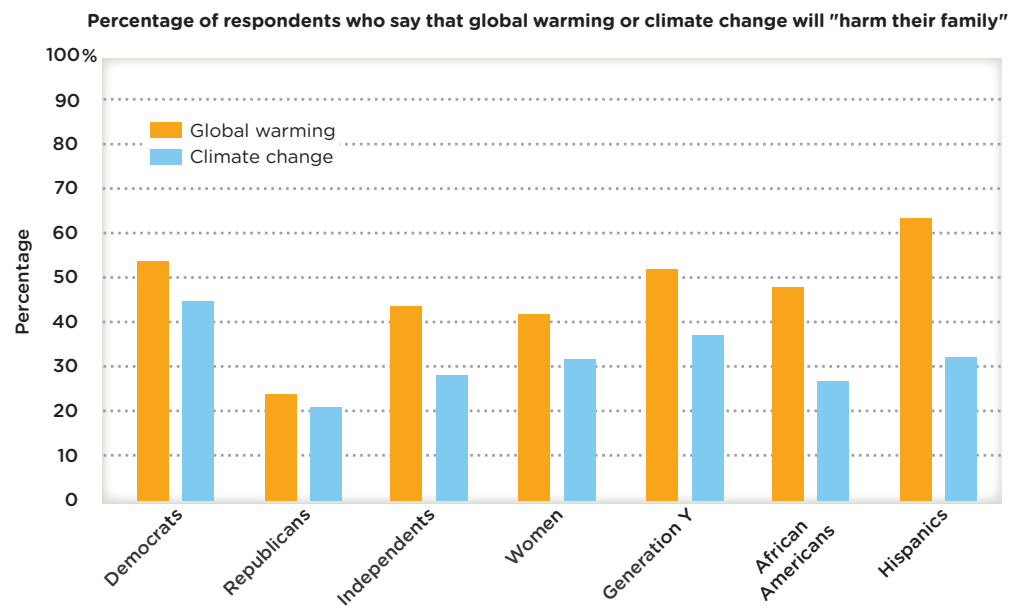


FIGURE 2.2

It Depends How You Ask

What do global warming and climate change mean to you? To compare the impact of these two phrases, researchers surveyed a representative sample of U.S. adults. About half of the participants answered a series of questions about *global warming*, while the other half answered the exact same questions about *climate change*. In the example here, we can see how differently people reacted to these variations in wording: "how much do you think global warming will harm your family?" versus "how much do you think climate change will harm your family?" (Leiserowitz et al., 2014, p. 18). Apparently, global warming sets off more alarm bells than climate change, and this influences the way people answer questions about the issue. Information from Leiserowitz et al. (2014).

propensity toward social desirability may lead to inaccurate representations of participants' attitudes and behaviors.

SKIMMING THE SURFACE Another disadvantage of the survey method is that it tends to skim the surface of people's beliefs or attitudes, failing to uncover *why* people respond the way they do. Ask 1,000 people if they *intend* to exercise regularly, and you might get a substantial number of affirmative responses. But *yes* might mean something quite different from one person to the next ("Yes, it crosses my mind, but I can never go through with it" versus "Yes, I have a specific plan, and I have been able to follow through"). To obtain more precise responses, researchers conducting surveys often ask people to respond to statements using a scale indicating the degree to which they agree or disagree (for example, a 5-point scale ranging from *strongly agree* to *strongly disagree*), or the degree to which they have had an experience (a 5-point scale ranging from *never* to *almost always*).

A SAMPLING PROBLEM Another common challenge is obtaining a representative sample. Many surveys fail to do so because their *response rates* fall short of ideal. If a researcher sends out 100 surveys to potential participants and only 20 people return them, how can we be sure that the answers of the 20 responders reflect those of the entire group? Without a representative sample, we cannot generalize survey findings to the larger population. How can researchers get more people to respond to their surveys? Paying participants a small sum (about \$3.00, in one study) may increase the response rate (Robb, Gating, & Wardle, 2017).

CORRELATIONS: IS THERE A RELATIONSHIP?

LO 4 Describe the correlational method and identify its limitations.

When researchers collect data on many variables, it can be useful to determine if these variables are related to each other in some way. The **correlational method** examines relationships among variables and assists researchers in making predictions. A **correlation** represents a relationship or link between variables (INFOGRAPHIC 2.2 on the next page). For example, there is a correlation between the amount of time parents spend reading books to their children and the number of vocabulary words the children know. The more the parents read, the more words their children learn (Pace, Luo, Hirsh-Palek, & Golinkoff, 2017). This is an example of a positive correlation. As one variable increases, so does the other. Positive correlations also work the opposite way: As one variable decreases, so does the other. The less time parents spend reading, the fewer vocabulary words their children know. Even though values of both variables are decreasing, this still represents a positive relationship. A negative correlation, on the other hand, means that as one variable goes up, the other goes down (an inverse or negative relationship). An example might be the quantity of time college students spend using their smartphones and their performance in school. As phone usage increases, academic performance decreases (Samaha & Hawi, 2016). You have probably noticed correlations between variables in your own life. Increase the hours you devote to studying, and you will likely see your grades go up (a positive correlation). The more you go shopping, the less money you have in the bank (a negative correlation).

CORRELATION COEFFICIENT Some variables are tightly linked, others weakly associated, and still others not related at all. Lucky for researchers, there is one number that indicates both the strength and direction (positive or negative) of the relationship: a statistical measure called the **correlation coefficient**, symbolized as r . Correlation coefficients range from +1.00 to -1.00, with positive numbers indicating a positive relationship between variables and negative numbers indicating an inverse (negative) relationship between variables. The closer r is to +1.00 or to -1.00, the stronger the relationship. The closer r is to 0.00, the weaker the relationship. When the correlation coefficient is very close to zero, there may be no relationship at all between the variables. For example, consider the variables of shoe size and intelligence. Are adults with bigger (or smaller) feet more intelligent? Probably not; there would be no link between these two variables, so the correlation coefficient between them (the r value) is around zero. Take a look at Infographic 2.2 to see how correlation coefficients are portrayed on graphs called *scatterplots*.

DIRECTIONALITY Now let's consider the direction of the relationship between variables. Some researchers have reported a positive relationship between exposure to violence in media and aggressive behavior (Bushman et al., 2016; Coyne, Warburton, Essig, & Stockdale, 2018). Since there appears to be a positive correlation, you might assume that media exposure leads to aggression. The more violent video games a child plays, the more aggressive he is. But could it be that aggressive children are more likely to be attracted to violent video games in the first place? If this is the case, then aggressive tendencies influence the amount of time spent using violent media, not the other way around. The direction of the relationship (*directionality*) matters. If we are talking about the relationship between aggression and exposure to violent media, the causal relationship could potentially go in both directions (Coyne, 2016).

correlational method A type of research examining relationships among variables.

correlation An association or relationship between two (or more) variables.

correlation coefficient The statistical measure (symbolized as r) that indicates the strength and direction of the relationship between two variables.

The Correlation Coefficient: What's in a Number?

A correlation indicates a relationship between two variables, such as the amount of time you spend studying and the grade you get on a test. This relationship is often indicated using a correlation coefficient, symbolized as r . To interpret the relationship using a correlation coefficient (r), ask yourself two questions:

- (1) What is the *direction* of the relationship?
- (2) What is the *strength* of the relationship?

A *scatterplot* helps us see what the relationship looks like.

And remember, a correlation between two variables does not necessarily mean that one variable caused the change in the other variable.

$$r = +.73$$

What Is the Direction of the Correlation?

- **positive (+) correlation**
as one variable increases, the other also increases
- **negative (-) correlation**
as one variable increases, the other decreases (an inverse relationship)

Example: $+0.73$ is a positive number, showing a positive correlation. As hours spent studying increase, test grades also increase.

What Is the Strength of the Correlation?

- strength ranges from $+1.00$ to -1.00
- a value close to $+1.00$ or -1.00 is a **strong** correlation
 - a value close to 0.00 is a **weak** correlation

Example: $+0.73$ is close to 1.00 . This shows a strong correlation between hours spent studying and test grades.

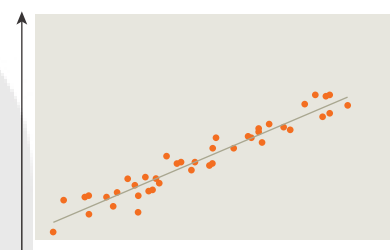
BEWARE of the potential Third Variable

Correlation does not indicate that one variable *causes* a change in the other. A **third variable** may have influenced the results.

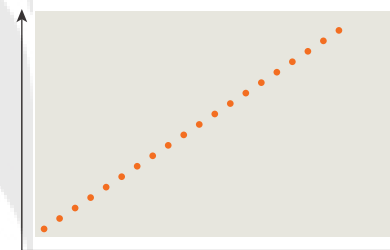
Example: Although time spent studying and exam grades are strongly and positively correlated, attendance is another variable. Students who attend classes regularly tend to spend more hours studying. Likewise, students who attend classes regularly know what to expect on the test and are therefore likely to get better grades.

What does the correlation look like?

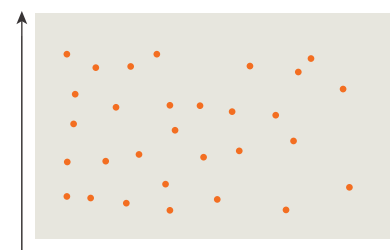
Using a scatterplot, we can express the relationship between two variables. One variable is labeled on the horizontal axis, and the second variable is labeled on the vertical axis. Each dot represents one participant's scores on the two variables. Notice how the shape of the graph changes depending on the direction and strength of the relationship between the variables.



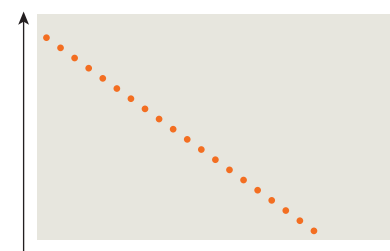
example:
 $+0.73$ (strong positive correlation)



perfect positive correlation ($+1.00$)



no relationship (0.00)



perfect negative correlation (-1.00)

THIRD VARIABLE Even if there is a very strong correlation between two variables, this does not indicate a causal link exists between them. No matter how high the r value is or how logical the relationship seems, a correlation is not equivalent to a cause-and-effect connection. Getting back to the positive relationship between exposure to violence in media and aggressive behavior, it's easy to jump to the conclusion that the exposure causes the aggression. But maybe some other variable is influencing both exposure to media violence and aggressive behavior. Can you think of any additional variables that might “cause” increases or decreases in aggression? One possibility is parenting behaviors; parents who limit and monitor exposure to violent media seem to have children who exhibit less aggressive behavior (Bushman et al., 2016). Perhaps some other quality of these parents (apart from their tendency to limit media exposure) causes their children to be less aggressive. Parenting style therefore would be considered a **third variable**, some unaccounted for characteristic of the participants or their environment that explains the changes in the two other variables (parent involvement influences both exposure to violence and aggressive behaviors). When you observe strong links between variables, consider other factors that could be related to both.

We have now discussed naturalistic observation, case studies, surveys, and the correlational method. These research methods cannot identify the causes of behaviors, but they can produce valuable results. Their findings may even guide important government decisions; just consider the following example.

Across the World

THE HAPPIEST PLACES ON THE PLANET



Have you ever wondered how happiness varies across the globe? That is, are people generally happier in some countries and less happy in others? According to the *World Happiness Report*, published by the United Nations Sustainable Development Solutions Network, happiness does vary according to geographic location. Finland is home to the happiest folks, while the runners-up are Denmark, Norway, and Iceland (FIGURE 2.3 on the next page). The United States fares a bit worse, claiming 19th place on the list of 156 countries. The unhappiest spots include South Sudan, Central African Republic, Afghanistan, and Tanzania (Helliwell, Layard, & Sachs, 2019).

**AND THE WINNER
IS . . . FINLAND!**

Why are some populations happier than others? As you might expect, countries with governments that are corrupt, unable to control conflicts, and generally ineffective tend to have less happy citizens. In the United States, happiness among adults and teens has declined since the 2000s, despite increasing per capita income and lower levels of unemployment and violent crime. Possible reasons for the drop in American happiness include substance abuse, obesity, and greater amounts of screen time. More time spent engaging with digital technologies may translate to less time communicating face-to-face, reading books, participating in religious activities, and other offline pursuits that could potentially raise happiness (Helliwell et al., 2019).

Apart from maintaining a healthy lifestyle and exercising moderation with digital technologies, what can we do to feel happier? The report calls special attention to *prosocial behaviors*—that is, behaviors aimed at benefiting others (Chapter 6). Being financially generous, even if the gesture is small (for example, buying a cookie or juice to be delivered to a hospitalized child), seems to provide a happiness boost for the giver. The same may be true for “random acts of kindness,” like holding the door for someone you don’t know, and being generous with your time (helping a

third variable An unaccounted for characteristic of participants or the environment that explains changes in the variables of interest.

**FIGURE 2.3****Happiness Hotspots**

Highlighted on this map are the 10 happiest countries in the world. Five of them—Finland, Denmark, Norway, Iceland, and Sweden—are Nordic countries. Why do you think people in this Northern European region are so content?

Information from Helliwell, Layard, and Sachs (2019).

coworker who is in a pinch; Helliwell et al., 2019, p. 74). Generous behaviors are more likely to increase happiness when helpers “feel free to choose whether or how to help,” “feel connected to the people they are helping,” and “can see how their help is making a difference” (p. 75).

The *World Happiness Report* is a great example of descriptive research, but what is the point of studying this topic? Happiness is associated with *sustainable development*, or development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (Helliwell, Layard, & Sachs, 2015; United Nations, General Assembly, 1987, August 4, p. 54). Sustainable development is about making economic progress, but also protecting the environment and the social needs of citizens. When these goals are balanced, human happiness and well-being are likely to increase. Some governments are beginning to appreciate this relationship and now use happiness data in making policy decisions (Helliwell et al., 2015).

In Class: Collaborate and Report



Team up and discuss the following: **A)** How should happiness be defined and measured? Propose an operational definition. **B)** How does cultural background influence your answer to A? **C)** Do you think it’s possible to create a universal definition of human happiness—why or why not?



SHOW WHAT YOU KNOW

- Descriptive research is primarily useful for studying:
 - operational definitions.
 - observer bias.
 - new or unexplored topics.
 - visual-spatial skills.
- A researcher studying parent behavior during preschool drop-off trains teachers to record how long it takes caregivers to enter and leave the classroom. This approach to collecting data is referred to as _____.
- Imagine you are about to give a presentation on descriptive research methods. How would you describe the similarities and differences of the methods presented in this section?
- If a researcher finds a positive correlation between smartphone use and absenteeism from work, why can’t she claim that phone use causes absenteeism?


✓ CHECK YOUR ANSWERS IN APPENDIX C.

The Experimental Method

TOGETHER AT LAST May 14, 2013, would be the most important day in the lives of Samantha Futerman and Anaïs Bordier. These young women, who shared a womb and came into the world together, would finally be reunited after 25 years of living on separate continents. The meeting would be captured on camera and become one of the most dramatic moments of their documentary film, *Twinsters*.

Sam and the movie crew landed at London's Heathrow Airport, collected their luggage, and headed straight to the apartment they had rented for the reunion. Shortly after they arrived, a few of Anaïs' friends came over, and the wait for Anaïs and her mother began. Sam, surging with adrenaline, did not know what to do with herself; she was excited and scared, wanting to hide. Then she heard it: a laugh coming from behind the door. It sounded just like her own, but it was Anaïs.

"I entered the room, and there was Sam," Anaïs recalls. "Neither of us knew what to do next, so we just stood in the middle of the room, staring at each other, like two tiny dogs sniffing each other out" (Bordier et al., 2014, p. 151). The twins watched each other in amazement, averting eye contact and periodically erupting in nervous laughter. At one point, Anaïs reached over to poke Sam, as if to see if she was real. "You don't know the person but you know her very well because you can read her perfectly," Anaïs explains. "It's the strangest thing."

After about 45 minutes, the whole group was emotionally exhausted and hungry. As they made their way toward a restaurant, Sam and Anaïs caught a glimpse of their reflection in a storefront window. "We both kind of stopped and were like, 'that is so weird,'" Sam recalls. "I'll never forget that moment." Following lunch, the twins returned to the apartment and took a nap together. Was it awkward crawling into bed and falling asleep with a person they had just met? "Not awkward at all," says Anaïs. "It took like two seconds." 

CONTROL IS THE GOAL

Napping is what Sam and Anaïs do when they feel overwhelmed. It helps them reset and recharge. Many people use caffeine to achieve the same effect; they rely on soda, coffee, or energy drinks to clear away the mental fog that descends on them every afternoon. Research has linked low to moderate caffeine intake with various benefits, including improved attention and mood, and increased alertness (McLellan, Caldwell, & Lieberman, 2016; Wilhelmus et al., 2017). Suppose you are interested in researching how caffeine impacts one of these variables—let's say increased attention. How could you isolate the effects of caffeine when so many other factors could potentially affect attention, such as nutrition, sleep habits, and physical health? There is a research method that allows you to monitor these possible sources of interference: the *experimental method*. Using this method in a controlled laboratory environment has many benefits; you have greater control over who participates in the study, more freedom to manipulate variables, and the ability to draw comparisons between groups that differ only with respect to your target variables.

LO5 Explain how the experimental method can establish cause and effect.

Unlike the descriptive methods discussed earlier, the **experimental method** can tell us about cause and effect, as it aims to ensure that every variable except those being manipulated by the researcher is held constant or controlled (see **INFOGRAPHIC 2.3** on p. 47).



The First Meeting

Sam and Anaïs' first meeting was both happy and stressful. Although this photo doesn't show them, several of their close friends were also there to witness the momentous event. As Anaïs recalls, "It felt like a big family, so it was really comforting."

Twinsters (2015). Small Package Films.

You Asked, Sam and Anaïs Answer

<http://qrs.ly/2r77rvp>

Did you connect immediately? How long was the process?

scan this

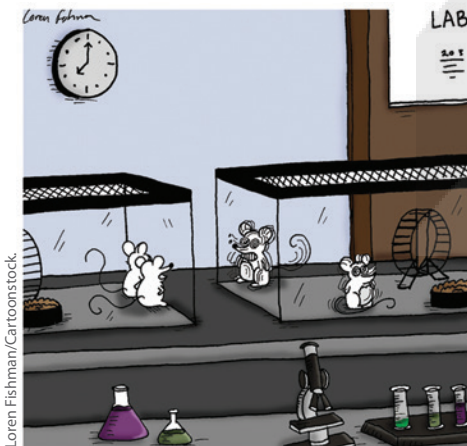


experimental method A type of research that manipulates a variable of interest (independent variable) to uncover cause-and-effect relationships.

So how does the experimental method allow us to control variables? The researchers randomly assign participants to two or more groups that they try to make equivalent with respect to all variables, with one key exception: the treatment or manipulation being studied. If the groups differ on the variable of interest following this treatment or manipulation, we can say with confidence that the experimental manipulation caused that change. In this way, the experimental method allows researchers to observe the variable of interest without interference from other variables.

If you are having trouble understanding what it means to control variables, consider this analogy: You are outside a football stadium, desperately trying to follow a friend lost in a swarm of people. Everyone is moving in different directions, making it exceedingly difficult to pinpoint your friend's location and direction of movement. But what if everyone in the crowd except your friend froze for a moment? Would it be easier to observe him now that he is the only one moving? This is similar to what researchers try to do with variables—hold everything steady except the variables they are examining.

How might you design a study using the experimental method? Suppose you want to investigate how caffeine impacts attention. Your hypothesis is the following: *Participants given a moderate dose of caffeine will perform better on a task that requires increased attention compared to participants given a sugar pill.* To test this hypothesis, you need to put together a group of participants who are very similar in age, educational background, physical health, and other variables that might affect their ability to stay attentive. Next, you divide the participants into two groups: one that receives caffeine supplements and another that gets a sugar pill. After participants take the treatment or sugar pill for a designated amount of time, you compare the two groups' performance on the same tasks measuring attention. If the group receiving the caffeine supplements performs better, then you can attribute that difference to caffeine. This may sound straightforward, but there are still some critical concepts you need to understand.



"Well, I guess we're the control group."

random assignment The process of appointing study participants to experimental or control groups, ensuring that every person has an equal chance of being assigned to either.

RANDOM ASSIGNMENT Assigning participants to groups is a crucial step in the experimental method. Fail to divide participants in the correct way and your whole study is compromised. For this reason, researchers use **random assignment** to ensure that participants have an equal chance of being assigned to any of the groups. Randomly choosing which treatment the participants receive reduces the possibility that some other variable (a characteristic of the participants, such as age or sensitivity to caffeine) will influence the findings. You can flip a coin, roll dice, or use a computer to generate numbers, but the goal of random assignment is always the same: to ensure that the groups are roughly equal on all characteristics. If the groups are lopsided with respect to some variable, the results may be affected. Getting back to your caffeine study, imagine that you assigned all the teenage participants to one group and all the middle-age participants to the other. Might age influence the results of a test measuring attention? Perhaps. Random assignment helps reduce some of the interference resulting from such characteristics.

You may have noticed some similarities between *random assignment* and *random sample* introduced earlier in the chapter. Here's the difference: Random sampling is used at the onset of a study to gather participants from a larger population. Random assignment comes into play later, when you are assigning participants to different groups.

EXPERIMENTAL AND CONTROL GROUPS Returning to your study on caffeine supplements and attention, let's assume you did use random assignment to divvy your participants into two groups. One group receives the treatment (a daily dose

of caffeine), and the other gets no treatment at all. (They are handed a sugar pill that looks identical to the caffeine supplement, or they are given nothing.) Those who get the treatment (caffeine supplements) comprise the **experimental group**, and those who get no treatment (a sugar pill or nothing at all) are members of the **control group**. You need a control group for the purpose of comparison: To determine the effects of the treatment, you must compare it to the effects of no treatment.

INDEPENDENT AND DEPENDENT VARIABLES Let's restate a point we already made earlier in the section, this time using some new vocabulary terms: The only difference between the experimental and control groups should be the variable researchers are manipulating—in this case, caffeine intake. The different treatment given to the two groups is called the **independent variable (IV)**, because it is the one variable the researchers are deliberately changing. (In this case, some participants get caffeine, others a sugar pill or nothing at all.) This is a critical point, and it's worth restating: In the experimental method, the independent variable is the variable researchers are manipulating. Because of the complex nature of human behavior, there may be more than one independent variable in a given experiment.

The **dependent variable (DV)** refers to the characteristic or response researchers are observing or measuring. As with the independent variable, there may be more than one dependent variable in a given study. In our hypothetical experiment, the dependent variable is the participants' performance on various attention tasks. Just remember, the independent variable is what the researchers are manipulating, and the dependent variable is what they are measuring as a result of that manipulation. In other words, researchers are trying to determine whether the dependent variable (in this case, performance on the attention tasks) "depends" on the independent variable (caffeine supplement or sugar pill).

EXTRANEOUS VARIABLES When planning experiments, researchers must take steps to ensure that **extraneous variables** do not interfere with their measures. Extraneous variables are characteristics of the environment or participants that could potentially affect the outcome of the research. While conducting your study of caffeine supplements, you discover that three of the participants are particularly sensitive to caffeine; even small doses make it very difficult for them to sleep at night. Their resulting sleep deprivation can definitely influence performance on attention tasks. Unfortunately, you failed to consider this very important variable in your research design, and thus it is an extraneous variable. Researchers must carefully contemplate the many different kinds of variables that could influence the dependent variable.

In some cases, extraneous variables can *confound* the results of an experiment. A **confounding variable** is a type of extraneous variable that changes in sync with the independent variable, making it very difficult to discern which variable—the independent variable or the confounding variable—is causing changes in the dependent variable. Imagine the lab is not big enough to accommodate all participants at once, so you collect data from the experimental group in the morning and the control group in the evening. But when you compare the two groups' performance on attention tasks, how can you be sure their differences result from the caffeine supplements, and not the time of day the data were collected? The effects of caffeine may depend on whether it is consumed in the morning or afternoon (Sherman, Buckley, Baena, & Ryan, 2016). And perhaps the behavior of the lab assistants changes as the day wears on, which, in turn, could influence the behavior of participants. Do you see how the time of day, and certain variables associated with it, could be confounding variables?

experimental group The participants in an experiment who are exposed to the treatment variable or manipulation by the researcher; represents the treatment group.

control group The participants in an experiment who are not exposed to the treatment variable; this is the comparison group.

independent variable (IV) In the experimental method, the variable manipulated by the researcher to determine its effect on the dependent variable.

dependent variable (DV) In the experimental method, the characteristic or response that is measured to determine the effect of the researcher's manipulation.

extraneous variable A characteristic of participants or the environment that could unexpectedly influence the outcome of a study.

confounding variable A type of extraneous variable that changes in sync with the independent variable, making it difficult to discern which one is causing changes in the dependent variable.

The good news is that we can take steps to minimize the influence of extraneous variables. That is, we can control variables. Earlier, we explained how researchers control variables with the help of random assignment. In the caffeine study, that would help to ensure that both groups have approximately the same number of participants who are sensitive to caffeine (meaning they don't sleep well after using it). Another way to control the impact of caffeine sensitivity is to remove the caffeine-sensitive participants from your sample and not include their information in your statistical analyses. Finally, you can minimize the influence of extraneous variables by treating the experimental and control groups exactly the same; for example, giving them attention tests at the same time and location.

If you succeed in holding all variables constant except the independent variable, then you can make a statement about cause and effect. Let's say your study does uncover differences between the experimental and control groups on attention tasks. It is relatively safe to attribute that disparity to the independent variable. In other words, you can presume that the caffeine supplements caused the superior performance of the experimental group.

QUASI-EXPERIMENTAL DESIGN In some cases, random assignment is not possible. Suppose a researcher is studying treatments for psychological disorders, and she wants to include one group of people with depressive disorders and another group with anxiety disorders. She cannot expect to achieve this goal using random assignment. Similarly, a researcher studying spanking cannot rely on random assignment to produce one group of participants who use physical punishment to discipline their children and another group who don't. Nor would it be ethical to instruct some parents in the study to spank and others to refrain from spanking. When random assignment is not an option, participants may be assigned to groups based on a characteristic that exists before the study begins; a study that uses this approach is considered *quasi-experimental* (Campbell & Stanley, 1963). The quasi-experimental design is not ideal, but sometimes it's the best the researcher can do. In these situations, the researcher must be aware of the confounding factors that could influence the outcome of the study, and to control for them as best as possible.

WHAT DO YOU EXPECT?

When using the experimental method (or any type of research design), researchers may employ deception to help control for extraneous variables. In a *single-blind study*, for example, participants do not know what treatment they are receiving. With a **double-blind study**, both the participants and the researchers working directly with those participants are unaware who is getting the real treatment and who is getting the pretend treatment. In your caffeine study, this would mean that the people administering the pills and the cognitive tests would not know who was receiving the caffeine supplement and who was receiving the sugar pill. Nor would the participants be privy to this information. Keeping participants in the dark is relatively easy; just make sure the treatment and sugar pill appear identical. Concealing details from the researchers is a little trickier but can be accomplished with the help of clever assistants who make it appear that all participants are getting the same treatment. Why is the double-blind study such a strong experimental design? It has to do with what's going on inside the minds of both participants and researchers.

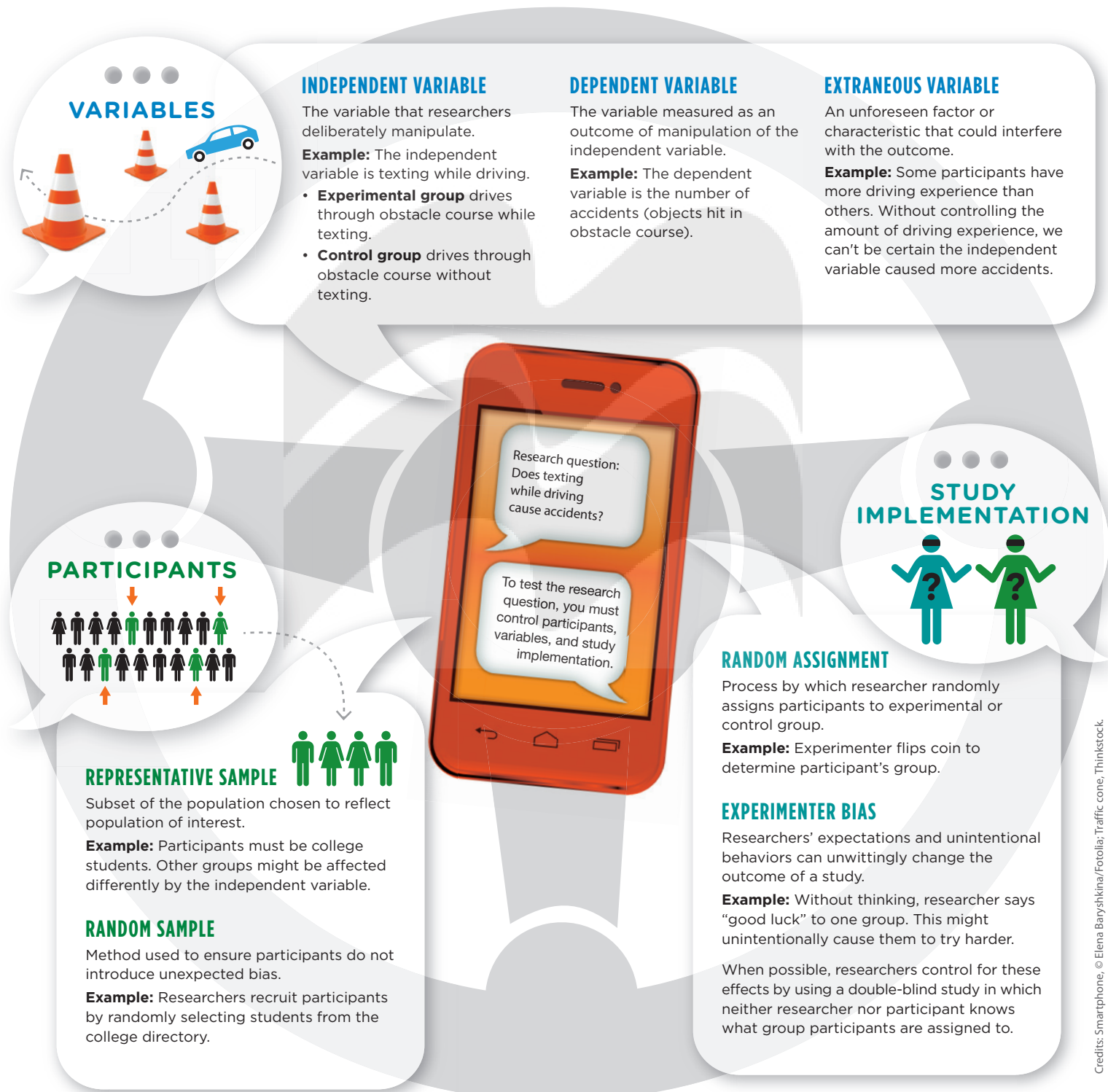
double-blind study Type of study in which neither the participants nor the researchers administering the independent variable know which participants are receiving the treatment and which are getting the placebo.

THINKING IS BELIEVING Prior research tells us that the expectations of participants can influence results. If someone hands you a cup of decaf coffee and says it is regular, you may feel energized after drinking it because you *think* it is caffeinated. Similarly, if someone gives you a sugar pill but tells you it is real medicine, you might

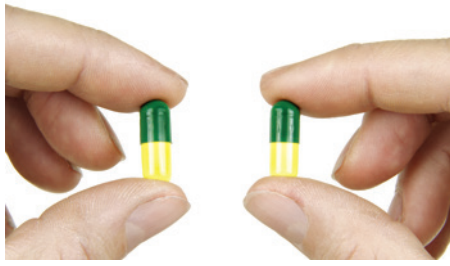
The Experimental Method: Are You in Control?

The experimental method is the type of research that can tell us about causes and effects. It is different from descriptive studies in that key aspects of the experiment—participants, variables, and study implementation—are tightly controlled. The experiment typically includes at least two groups—an experimental group and a control group. This allows the researcher to isolate the effects of manipulating a single variable, called the independent variable.

Imagine you want to know if laws that ban texting while driving are worthwhile. Does texting really *cause* more accidents? Perhaps texting is merely correlated with higher accident rates in certain populations, such as college students, because college students are both more likely to text and more likely to have accidents. In order to find out, you have to perform an experiment.



Credits: Smartphone, © Elena Baryshkina/Fotolia; Traffic cone, Thinkstock.



Looks Real

One of these pills contains an active ingredient; the other is a placebo. People taking placebos often experience benefits that are similar to those reported by participants receiving the actual drug. They can even experience similar side effects (Colloca, 2017). Cordelia Molloy/Science Source.

end up feeling better simply because this is what you expect will happen. Apparently, thinking is believing. When people are given a fake pill or other inactive “treatment,” known as a **placebo** (pluh-SEE-bo), they often get better even though the contents of the pill are inert. The power of this *placebo effect* may depend partly on social context. In one study, participants experienced greater improvement when the person delivering their placebo displayed warmth and competence (Howe, Goyer, & Crum, 2017). Remarkably, the placebo effect has been shown to ease pain, anxiety, depression, and even symptoms of Parkinson’s disease. And although placebos are not able to shrink the size of tumors, they can help with some of the side effects of treatment, such as pain, fatigue, and nausea (Kaptchuk & Miller, 2015). Researchers believe that the placebo effect arises through both conscious expectations and unconscious associations between treatment cues and healing, and these psychological processes may influence what happens on a physiological level. Expectations can influence the placebo’s effect on the body.

EXPERIMENTER BIAS We’ve discussed the rationale for keeping participants in the dark, but why is it necessary to keep the researchers clueless as well? Researchers’ expectations can influence the outcome of a study, a phenomenon known as **experimenter bias**. A researcher may unwittingly color a study’s outcome through subtle verbal and/or nonverbal communication with the participants, conveying hopes or beliefs about the experiment’s results (Nichols & Edlund, 2015). Saying something like “I really have high hopes for this medicine” might influence participants’ reactions to the treatment. The researcher’s value system may also impact the results in barely noticeable but very important ways. Beliefs and attitudes can shape the way a researcher frames questions, tests hypotheses, or interprets findings (Rosenthal, 1966, 2002; Stanley, Carter, & Doucouliagos, 2018).



Smart Horse, or Biased Humans?

“Clever Hans,” pictured here with his trainer Wilhelm von Osten, was a horse that appeared to be capable of counting, solving math problems, and a host of other cognitive tasks. When prompted with a question, Hans would signal the right answer by tapping his hooves. But as it turned out, Hans was just a brilliant reader of human behavior: By looking at the person asking the questions, Hans could tell when he was about to answer correctly. If Hans was wearing blinders, his amazing problem-solving ability vanished (Pfungst, 1911; Samhita & Gross, 2013). The case of “Clever Hans” illustrates experimenter bias, or the tendency for the experimenter’s views or expectations to color the results of a study (Rosenthal, 1965). akq-images/The Image Works.

placebo An inert substance given to members of the control group; this fake treatment has no benefit but is administered as if it will.

experimenter bias Researcher expectations that influence the outcome of a study.

reliability The consistency or stability of a measure.

validity The degree of accuracy of data collection methods; assessments measure what they intend to measure.

LO6 Explain why reliability and validity are important.

RELIABILITY AND VALIDITY When evaluating a study, we should consider two important qualities of the measures used to collect data—reliability and validity. **Reliability** refers to the consistency or stability of a measure, and there are two subtypes you need to know about. *Test–retest reliability* is how consistent results are when the same person is assessed more than once. Suppose you take a survey measuring some aspect of your personality. From one day to the next, your personality is unlikely to change, so your results shouldn’t either. With a reliable measure, the results should be very similar at different points in time. *Interrater reliability* refers to the consistency across people measuring a particular variable or scoring an assessment. With high interrater reliability, the results are the same regardless of who takes the measurement or scores the assessment.

The other important quality of an experiment is the **validity** of its measures, that is, how accurate the data collection methods are. An assessment tool is considered valid if it measures what it intends to measure. For example, a valid personality test measures personality characteristics, not some other quality such as intelligence. When examining an entire study, we should consider both its *internal validity* and *external validity*. If an experiment has internal validity, its design allows it to measure what it intends to measure (Campbell & Stanley, 1963). Problems with extraneous variables jeopardize the internal validity of an experiment, making it difficult to determine a causal relationship between the independent variable and the dependent variable. Establishing internal validity may be challenging with quasi-experimental designs, as we often don’t know if changes in the dependent variable result from the researcher’s manipulations or some preexisting characteristics of the participants.

TABLE 2.2 Research Methods: Pros and Cons

Research Method	Advantages	Disadvantages
Descriptive	Good for tackling new research questions and studying phenomena in natural environments.	Very little control; increased experimenter/participant bias; cannot determine cause and effect.
Correlational	Shows whether two variables are related; useful when an experimental method is not possible.	Directionality and third-variable problems; cannot determine cause and effect.
Experimental	Can determine cause and effect; increased control over variables.	Results may not generalize beyond lab setting; potential for extraneous variables.

How does a researcher choose which method to use? It depends on the research question. Each approach has advantages and disadvantages.


That is, we don't know if we have measured what we initially intended to measure. When an experiment has external validity, that means its findings can be generalized to the population of interest. Studies that use representative samples are more likely to have external validity; the results can be generalized from samples to populations.

NOTHING IS PERFECT You have now learned the nuts and bolts of the experimental method, one of psychology's greatest myth-debunking, knowledge-gathering tools. The experimental method is also distinguished by its ability to establish cause and effect. But like any scientific approach, this method does have some drawbacks. Laboratory settings are inherently unnatural and therefore cannot always paint an accurate picture of behaviors that would occur in a natural setting. When people know they are being observed, their behavior changes; researchers call this the *Hawthorne effect* (Goodwin et al., 2017; Olson, Verley, Santos, & Salas, 2004). Other weaknesses of the experimental method include cost (it's expensive to maintain a laboratory) and time (collecting data in a laboratory setting can be much slower than, say, sending out a survey). Finally, there are instances when it is not possible (or ethical) to manipulate certain variables. **TABLE 2.2** gives an overview of some of the advantages and disadvantages of the research methods we have described here.

Before we move on, let's test our understanding of the experimental method with the help of a sprightly yellow square named SpongeBob.

Didn't See That Coming

SPONGEBOB ON THE BRAIN

 A little television won't hurt a child, will it? Kids' programs are interspersed with lessons on colors, words, and numbers, and only run for periods of 20 to 30 minutes. It seems reasonable to assume that little snippets of TV can't possibly have any measurable effect.

When it comes to the rapidly developing juvenile brain, it's probably not safe to assume anything. Consider the following experiment examining the cognitive changes observed in preschool children after just 9 minutes of exposure to a talking yellow sponge zipping across a television screen.

The research participants were sixty 4-year-olds, most of whom came from White, upper-middle-class households. Researchers randomly assigned the children to one of three conditions: watching the extremely fast-paced cartoon *SpongeBob SquarePants*, viewing an educational program, or drawing with crayons and markers. Following 9 minutes of the assigned activities, the children took a series of four commonly used tests to assess their executive function—the collection of brain processes involved in self-control, decision making, problem solving, and other higher-level functions.

TURNING YOUNG BRAINS TO "SPONGE"?



Sponge Brain

We don't expect cartoons to make kids smarter, but can they hurt them? One study suggests that preschool children watching just 9 minutes of the high-energy, ultra-stimulating kids' show *SpongeBob SquarePants* experience a temporary dip in cognitive function. HANDOUT/KRT/Newscom.

The results were shocking: Children in the SpongeBob group performed considerably worse than those in the other groups (Lillard & Peterson, 2011). Just 9 minutes of SpongeBob produced a temporary lapse in cognitive function.

How do we know that this was not the result of a different variable, such as some children's preexisting attentional issues or television-watching habits at home? Those factors were accounted for in the study. In the experimental method, researchers hold nearly all variables constant except the one they want to manipulate—the 9-minute activity, in this case. This is the independent variable (IV). In this way, the researchers can be somewhat confident that changes in the IV are driving changes in the dependent variable (DV)—performance on the cognitive tests.

What aspect of the cartoon caused this effect? The researchers hypothesized it had something to do with the show's "fantastical events and fast pacing" (Lillard & Peterson, 2011, p. 648), and a subsequent study suggests that the fantastical content may be the problem. Shows that are highly fantastical, or involve "physically impossible events" (for example, cartoon characters that magically change shape or disappear in puffs of smoke), seem to compromise short-term executive function in a way that non-fantastical shows do not. The negative impact of fantasy is even apparent with slow-paced programs like *Little Einsteins* and "educational" shows such as *Martha Speaks* (Lillard, Drell, Richey, Boguszewski, & Smith, 2015). Skeptics point out that findings from the original SpongeBob study have been difficult to replicate and that children are exposed to fantastical content elsewhere, even in classic storybooks such as *Where the Wild Things Are* by Maurice Sendak (Scarf & Hinten, 2018). And who could argue that imaginative storybooks are bad for children? In fact, research suggests that exposure to fantastical content in books has cognitive benefits, such as increased vocabulary development (Weisberg et al., 2015).

Many questions remain, but parents would be wise to impose limits on electronics use, as greater amounts of screen time have been linked to slower development in young children. The relationship is not so surprising: "When young children are observing screens, they may be missing important opportunities to practice and master interpersonal, motor, and communication skills" (Madigan, Browne, Racine, Mori, & Tough, 2019, p. E5). ⚡

In Class: Collaborate and Report



Team up and discuss the following: A) Did the original SpongeBob study use a representative sample of U.S. children? B) Identify the experimental and control groups in this study. C) Using the study findings, can you assume that watching *SpongeBob SquarePants* will have a lasting impact on children's executive function? D) What kind of study would you conduct to determine the long-term cognitive effects of watching *SpongeBob*?



SHOW WHAT YOU KNOW

- A study of preschool children examined the impact of watching fast-paced cartoons on executive functioning. Half of the children were assigned to watch *SpongeBob* in a room alone. The other half were assigned to draw for the same amount of time while sitting at a table with other children. The researcher mistakenly introduced a confounding variable, which was:
 - whether the child watched the cartoon or not.
 - whether the child was alone or with others.
 - whether the child was drawing or not.
 - whether activity times were the same for each group.
- The experimental method can provide findings on the _____ of variables.
 - experimenter bias
 - confounding
 - random assignment
 - cause-and-effect relationship
- When evaluating a study, it's important to consider the reliability and validity of data collection measures. How might unreliable and invalid measures impact your interpretation of findings from a study on caffeine and attention?

✓ CHECK YOUR ANSWERS IN APPENDIX C.

Analyzing the Data

In this chapter, we have presented various methods for gathering data. But how do we analyze these data and use them in a meaningful way? This is where *statistics* comes in. **Statistics** is the science of collecting, organizing, analyzing, displaying, and interpreting data. There are two basic types of statistics: *descriptive* and *inferential*. Let's take a closer look at both categories.

DESCRIPTIVE STATISTICS

LO7 Define and give examples of descriptive statistics.

With **descriptive statistics**, researchers summarize information they have gleaned from their studies. The raw data can be organized and presented through tables, graphs, and charts. We can also use descriptive statistics to represent the average and the spread of the data (how dispersed the values are). The goal of descriptive statistics is to describe data, or provide a snapshot of what has been observed in a study.

Psychologists often describe their data sets using numbers that express important characteristics: measures of central tendency, measures of variation, and measures of position. These numbers are an important component of descriptive statistics, as they provide a current view of a data set.

MEASURES OF CENTRAL TENDENCY If you want to understand human behaviors and mental processes, it helps to know what is typical, or standard, for the population. What is the average level of intelligence? At what age do most people experience first love? To answer these types of questions, psychologists can calculate **measures of central tendency**, which are numbers representing the “middle” of data sets. There are several ways of doing this. The **mean** is the arithmetic average of a data set. Most students learn how to calculate a mean, or “average,” early in their schooling. Another measure of central tendency is the **median**—the number representing the position in the middle of a data set. In other words, 50% of the data values are greater than the median, and 50% are smaller. A third measure of central tendency is the **mode**, which is the most frequently occurring value in a data set. If there is only one such value, we call it a *unimodal* distribution. **FIGURE 2.4** shows you how to calculate the mean, median, and mode.

MEASURES OF VARIATION In addition to information on the central tendency, psychologists are interested in **measures of variation**, which describe how much variation or dispersion exists in a data set. There are several measures we can use to characterize the *variability*, or variation, of a data set. The **range** represents the length of a data set and is calculated by taking the highest value minus the lowest value. Although it is a rough depiction of variability, the range is useful for comparing data on the same variable measured in two samples. A more precise measure of variation is the **standard deviation**, which essentially represents the average distance the data points are from their mean (**FIGURE 2.5** on next page). Think about it like this: If the values in a data set are very close to each other, they are also very close to their mean, and their dispersion is small. In other words, their average distance from the mean is small. If the values are widely spread, they are not all clustered around the mean, and their dispersion is great. Their average distance from the mean is large. Why is it important to know whether the dispersion is small or large? Consider exam scores like those in Figure 2.4. If the dispersion were small, that would

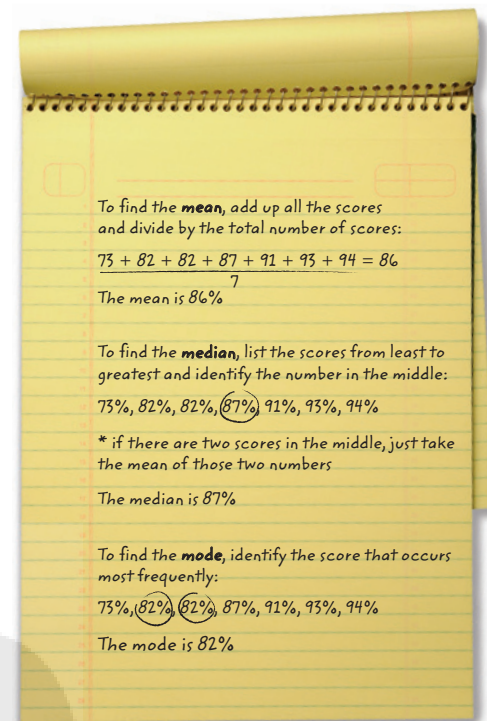


FIGURE 2.4

Measures of Central Tendency

Let's try calculating the mean, median, and mode for the following set of test scores: 73%, 82%, 82%, 87%, 91%, 93%, 94%. Notebook: pixhook/Getty Images.

statistics A science that focuses on how to collect, organize, analyze, display, and interpret data; numbers that describe characteristics of a sample.

descriptive statistics The presentation of data through tables, graphs, and charts; includes the use of values representing the average and spread of the data.

measures of central tendency Numbers that represent the middle of a data set.

mean The arithmetic average of a data set; a measure of central tendency.

median A number that represents the position in the data set for which 50% of the values are above it, and 50% are below it; a measure of central tendency.

mode The value of the data set that is most frequent; a measure of central tendency.

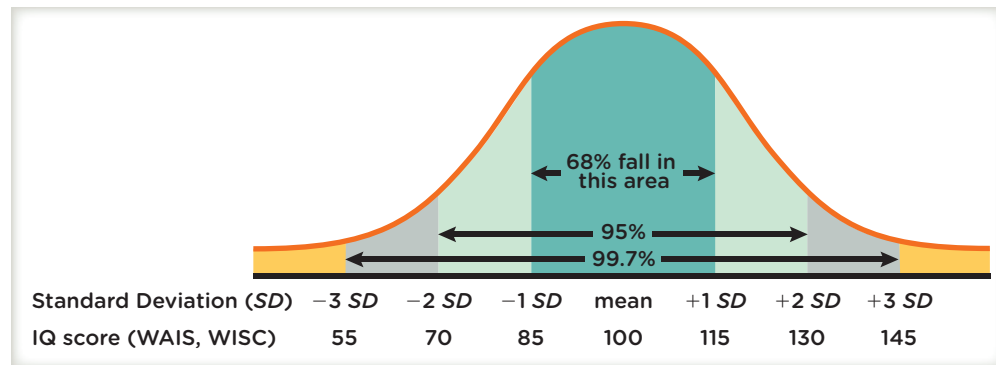
measures of variation Numbers that describe the variation or dispersion in a data set.

range A number that represents the length of the data set and is a rough depiction of dispersion; a measure of variation.

standard deviation A number that represents the average distance the values in a data set are from their mean; a measure of variation.

FIGURE 2.5**Standard Deviation**

If you look at the IQ scores displayed in the bell curve, you can see that 100 is the mean and 15 is the standard deviation. Looking at the dispersion, we see that 68% of people score between 85 and 115 (within 1 standard deviation above and below the mean); about 95% score between 70 and 130 (within 2 standard deviations); around 99.7% fall between 55 and 145 (within 3 standard deviations); and only a tiny percentage (0.3%) are below 55 or above 145 (more than 3 standard deviations from the mean).



indicate most students had similar scores. What would it mean if the dispersion were very large? Why might an instructor want to know this?

MEASURES OF POSITION Another way to describe data is by looking at *measures of position*, which represent where particular data values fall in relation to other values in a set. You have probably heard of *percentiles*, which indicate the percentage of values occurring above and below a certain point in a data set. A value at the 50th percentile is at the median, with 50% of the values falling above it and 50% falling below it. A value at the 10th percentile indicates that 90% fall above it and 10% fall below it. Often you will see percentiles in reports from standardized tests, weight charts, height charts, and so on. Going back to the exam scores—why might students want to know the percentile of their exam scores? Would it change your behavior if your score was at the 95th percentile versus the 5th percentile?

INFERENTIAL STATISTICS

LO 8 Define and give examples of inferential statistics.

Inferential statistics go beyond simple data presentation. With inferential statistics, for example, we can determine the probability of events and make predictions about general trends. The goals are to generalize findings from studies, make predictions based on relationships among variables, and test hypotheses. Inferential statistics also can be used to make statements about how confident we are in our findings based on the data collected.

HYPOTHESIS TESTING Earlier, we defined a *hypothesis* as a statement used to test a prediction. Once a researcher develops a hypothesis, she gathers data and uses statistics to test it. **Hypothesis testing** uses mathematical procedures to determine whether data support a hypothesis or simply result from chance. Let's look at an example to see how this works.

Suppose a researcher wants to determine whether taking vitamin D supplements can boost cognitive function. The researcher designs an experiment to test if giving participants vitamin D pills (the independent variable) leads to better performance on some sort of cognitive task, such as a memory test (the test score being the dependent variable). Participants in the experimental group receive doses of vitamin D, and participants in the control group receive a placebo. Neither the participants nor the researchers working directly with those participants know who is getting the vitamin D and who is getting the placebo, so it is a double-blind procedure. After collecting the data, the researcher compares the memory scores for the two groups to see if the treatment worked. In all likelihood, the average test scores of the two groups will

inferential statistics Analyses of data for determining the probability of events, generalizing findings, making predictions, and testing hypotheses.

hypothesis testing The use of mathematical procedures to determine the likelihood that a researcher's predictions are supported by the data collected.

differ simply because they include two different groups of people. So how does the researcher know whether the difference is sufficient to conclude that vitamin D had an effect? Using statistical procedures, the researcher can state with a chosen level of certainty (for example, with 95% confidence) that the disparity in average scores resulted from the vitamin D treatment. In other words, there is a slight possibility (in this case, 5%) that the difference was merely due to chance.

With the use of statistical methods, researchers can establish **statistical significance**, indicating that differences between groups in a study (for example, the average scores for treatment and control groups) are so great that they are likely due to the researcher's manipulations. That is, the mathematical analyses suggest a minimal probability the findings were due to chance. When we use the experimental method (that is, randomly assign individuals, manipulate an independent variable, and control extraneous variables) and find *statistically* significant differences between our experimental and control groups, we can be assured that these differences are very likely due to how we treated the participants (for example, administering the vitamin D treatment versus a placebo).

In addition to determining statistical significance, we also have to consider the *practical importance* of findings, meaning the degree to which the results of a study can be used in a meaningful way. In other words, do the findings have any relevance to real life? If the vitamin D regimen produces statistically significant results (with a performance gap between the treatment and control groups most likely not due to chance), the researcher still must determine its practical importance. Suppose the two groups differ by only a few points on the cognitive test; then the question is whether vitamin D supplementation is really worth the trouble. Just because something is statistically significant does not mean it is important in a practical sense.

We should note that big samples are more likely to result in *statistically* significant results (small differences between groups can be amplified by a large sample) even though the results might not provide much practical information. This phenomenon is further explained in the following piece published in *Scientific American*; it centers on an issue that comes up a few times in this chapter: media use and its effect on young minds.

THE KIDS (WHO USE TECH) SEEM TO BE ALL RIGHT

A rigorous new paper uses a new scientific approach that shows the panic over teen screen time is likely overstated.

Social media is linked to depression—or not. First-person shooter video games are good for cognition—or they encourage violence. Young people are either more connected—or more isolated than ever.

Such are the conflicting messages about the effects of technology on children's well-being. Negative findings receive far more attention and have fueled panic among parents and educators. This state of affairs reflects a heated debate among scientists. Studies showing statistically significant negative effects are followed by others revealing positive effects or none at all—sometimes using the same data set.

A new paper by scientists at the University of Oxford, published . . . in *Nature Human Behaviour*, should help clear up the confusion. It reveals the pitfalls of the statistical methods scientists have employed and offers a more rigorous alternative. And, importantly, it uses data on more than 350,000 adolescents to show persuasively that, at a population level, technology use has a nearly negligible effect

From the **SCIENTIFIC**
pages of **AMERICAN**

statistical significance The probability that the findings of a study were due to chance.

on adolescent psychological well-being, measured in a range of questions addressing depressive symptoms, suicidal ideation, pro-social behavior, peer-relationship problems and the like. Technology use tilts the needle less than half a percent away from feeling emotionally sound. For context, eating potatoes is associated with nearly the same degree of effect and wearing glasses has a more negative impact on adolescent mental health.

“This is an incredibly important paper,” says Candice Odgers, a psychologist studying adolescent health and technology at the University of California, Irvine, who wasn’t involved in the research. “It provides a sophisticated set of analyses and is one of the most comprehensive and careful accountings of the associations between digital technologies and well-being to date. And the message from the paper is painstakingly clear: The size of the association documented across these studies is not sufficient or measurable enough to warrant the current levels of panic and fear around this issue.”

To date, most of the evidence suggesting digital technologies negatively impact young people’s psychological well-being comes from analysis of large, publicly available data sets. Those are valuable resources but susceptible to researcher bias, say Andrew Przybylski, an experimental psychologist at Oxford and his graduate student Amy Orben, co-authors of the new paper. To prove their point, they found over 600 million possible ways to analyze the data contained in the three data sets in their study. “Unfortunately, the large number of participants in these designs means that small effects are easily publishable and, if positive, garner outsized press and policy attention,” they wrote.

This type of research intends to modify the status quo. “We’re trying to move from this mind-set of cherry-picking one result to a more holistic picture of the data set,” Przybylski says. “A key part of that is being able to put these extremely miniscule effects of screens on young people in real-world context.”

That context is illuminating. Whereas their study found digital technology use was associated with 0.4 percent of the variation that disrupts adolescent well-being, the effects of smoking marijuana and bullying had much larger negative associations for mental health (at 2.7 and 4.3 respectively in one of the data sets). And some positive behaviors such as getting enough sleep and regularly eating breakfast were much more strongly associated with well-being than the average impact of technology use. . . .

All of this is not to say there is no danger whatsoever in digital technology use. In a previous paper, Przybylski and colleague Netta Weinstein demonstrated a “Goldilocks” effect showing moderate use of technology—about one to two hours per day on weekdays and slightly more on weekends—was “not intrinsically harmful,” but higher levels of indulgence could be. . . . Lydia Denworth. Reproduced with permission.

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And now, a few questions for you to contemplate: (1) What does the study described above tell you about experimenter bias? (2) If you read that a finding is “statistically significant,” does that always mean it has significant implications for everyday life?

META-ANALYSIS We have discussed how variables are the focal points of experiments in psychology. Typically, the goal is to determine how one variable (the dependent variable) is affected by changes in another (the independent variable). Many studies focus on similar topics, so you might imagine it’s easy to compare their results. But this is not necessarily the case. Sometimes psychologists define variables

in different ways, or study the same variables with vastly different samples, methods of measurement, and experimental designs. How do we reconcile all their findings? We rely on a **meta-analysis**, a statistical approach that allows researchers to combine the findings of different studies and draw general conclusions. A meta-analysis is an objective, quantitative (measurable) mechanism for gathering and analyzing findings from a set of studies on the same topic (Braver, Thoemmes, & Rosenthal, 2014; Lakens, Hilgard, & Staaks, 2016). Meta-analyses can be useful for bringing perspective to hotly debated issues in the field. For example, in Chapter 6, you will read about a meta-analysis on the effects of spanking, which attempts to address some of the methodological problems of previous studies.

We have now examined several important research methods and statistical tools used in psychological studies. But there is more to research than designing studies and crunching numbers. At every step in the process, psychologists must consider the ethical implications of their work.

SHOW WHAT YOU KNOW

1. A classmate is collecting data for a research project incorporating an experimental group and a control group. When the data collection is complete, she will check for _____ to see if the differences between the two groups are due to the researcher's manipulations.
 - a. random sampling
 - b. descriptive statistics
 - c. standard deviations
 - d. statistical significance
2. How do descriptive and inferential statistics differ?
3. With descriptive statistics, researchers use tables, graphs, and charts to:
 - a. summarize data.
 - b. make inferences about data.
 - c. make predictions.
 - d. test hypotheses.

✓ CHECK YOUR ANSWERS IN APPENDIX C.

The Research Must Be Ethical

SHADY RESEARCH?

In the 1960s, researchers Peter Neubauer and Viola Bernhard launched an ethically dubious twin study in New York City. Their research focused on identical twins and triplets who had been given up for adoption and intentionally placed in separate homes. It was no secret a study was occurring, because the researchers periodically observed the children in their homes, interviewed the mothers, and administered tests. But neither the children nor the adoptive parents were told about the existence of the twin/triplet siblings being raised by other families (Perlman & Segal, 2005). Do you think this approach was fair to the adopted children and their families?

LO9 Demonstrate an understanding of research ethics.

Conducting psychological research carries an enormous ethical responsibility. Psychologists do not examine dinosaur fossils or atomic particles. They study humans and other living creatures who experience pain, fear, and other complex feelings, and it is their professional duty to treat them with dignity and respect.

In Chapter 13, you will learn about some of the most famous and ethically questionable studies in the history of psychology. These studies would never be approved today, as psychologists have established specific guidelines to help ensure ethical behavior in their field. Professional organizations such as the American Psychological Association (APA), the Association for Psychological Science (APS), and the British Psychological Society (BPS) provide written guidelines their members agree to follow.

meta-analysis A type of statistical analysis that combines findings from many studies on a single topic; statistics used to merge the outcomes of many studies.

TABLE 2.3 Ethical Use of Animals in Research

Guiding Principles	Ethical Conduct
Approving the use of animals	<ul style="list-style-type: none">• Before any nonhuman animal can be used in research, the Institutional Animal Care and Use Committee (IACUC) must approve the research methods as humane.
Housing animals	<ul style="list-style-type: none">• Researchers must meet standards that “exceed current regulations.”• The housing conditions will be inspected twice a year.• Their conditions must be “humane and healthful” and must be approved by the IACUC.
Obtaining animals	<ul style="list-style-type: none">• Animals must be obtained legally.• During transport, the animals must have access to food, water, ventilation, space.• No undue stress should be placed on the animal(s).
Experimenting on animals	<ul style="list-style-type: none">• The animals’ welfare must be part of the design of the experiment.• Only approved procedures are allowed by IACUC.
Animals in the classroom	<ul style="list-style-type: none">• Can be very useful in the classroom, but needs approval by the IACUC.• Psychologists should determine if the animal is necessary, or if there are “non-animal alternatives.”

The American Psychological Association (APA) provides guidelines for the ethical use of animals in research. The principles listed here are not exhaustive, and good judgment should be used. Information from APA (2012).

These guidelines attempt to ensure the ethical treatment of research participants, both human and nonhuman. (Keep in mind that notions of “ethical treatment” are highly variable; not everyone agrees with the codes established by these organizations.) The guidelines encourage psychologists to do no harm; safeguard the welfare of living beings in their research (TABLE 2.3); know their responsibilities to society and community; maintain accuracy in research, teaching, and practice; and respect human dignity, among other best practices (APA, 2010a).

HONESTY AND TRANSPARENCY

The ethical guidelines of psychology do not just apply to research protocols. In their writing and clinical practice, psychologists must be honest and respect the privacy of others.

WHOSE WORDS ARE THESE? As mentioned earlier, psychologists disseminate information by publishing articles in scientific journals. Along with this comes an ethical responsibility to give credit where credit is due. Using the activity below, explore how APA style supports the fair use of other people’s work.

In Class: Collaborate and Report



In your group, discuss the meaning of ‘fair use’ and explain how it differs from plagiarism. **A)** Pick any short paragraph in this chapter and copy it, word for word, at the top of a piece of paper. **B)** Copy the paragraph again, but this time include quotation marks at its beginning and end, and use APA style to cite the authors’ last names, year of publication, and page number from the textbook. **C)** Paraphrase the content of the paragraph in your own words, and use APA style to cite the authors’ last names and year of publication. **D)** Which of the paragraphs constitutes plagiarism and which would be fair use? Why is it important to cite other people’s work, and how do the APA guidelines make it obvious whose words are being used?

CONFIDENTIALITY An important component of ethical treatment is confidentiality. Researchers must take steps to protect research data from misuse or theft. Psychologists who offer therapy services are obligated to keep client and therapy session information



A Lofty Responsibility
A psychologist administers the Thematic Apperception Test to a child. (You will learn about this projective personality test in Chapter 12.) Conducting research on minors involves additional ethical considerations, and informed consent must be obtained from parents or legal guardians. Lewis J Merrim/Getty Images.

confidential; in fact, they are required to safeguard this information in their offices. Confidentiality enables clients to speak freely about deeply personal issues. It ensures that research participants feel protected when they share sensitive information (about sexual or controversial matters, for example), because they may rest assured researchers will keep it safe.

There are some occasions when psychologists are legally required to break confidentiality: for example, when a client is a danger to self or others (including the psychologist); in cases of abuse, neglect, or domestic violence; or when the psychologist receives a court order (APA, n.d.-b). At the client's request, psychologists may also share confidential information with an organization, physician, or legally authorized individual. Additionally, psychologists may share a limited amount of information in order to receive payment for services, but only the "minimum that is necessary" (APA, 2017, para. 4.05).

INFORMED CONSENT Ethical treatment also involves sharing information. Researchers have a duty to tell participants as much as they can about a study's purpose and procedures; they do this through *informed consent* and *debriefing*. Suppose a researcher has chosen a population of interest and identified her sample. Before enlisting these people as participants and collecting data, she must make certain that they are comfortable with their involvement. Through **informed consent**, participants acknowledge that they understand what their participation will entail, including any possible harm that could result. Informed consent is a critical part of Dr. Segal's twin studies. "You prepare a letter, and you have to keep a copy yourself, and give [the participants] a signed copy as well," she explains. "It lays out everything they will be doing, what some of their benefits are, what some of the risks might be, and that you will ensure them confidentiality. You don't give away hypotheses, but you speak about the research in a more general way because you don't want to bias the findings. It's kind of like your contract with them, and they're also free to withdraw from the study or refuse to do something at any point." Informed consent is a participant's way of saying, *I understand my role in this study, and I am okay with it*. It's also the researcher's way of ensuring that participants know what they are getting into.

DEBRIEFING Following a study, there is a second step of disclosure called **debriefing**. In a debriefing session, researchers provide participants with useful information about the study; in some cases, this means revealing any deception or manipulation used—information that couldn't be shared beforehand. Remember that deception is a key part of the double-blind study. Other types of psychological research require deception as well. In this book, you will learn about experiments in which participants were initially unaware of the study's purpose. In some cases, researchers purposely lied to participants, either because it was part of the manipulation, or because they needed to conceal the study's objective until the debriefing phase.

Why would researchers need to conceal the purpose of the experiment in the first place? Sometimes, people don't behave naturally when they know they are being observed. Participants may try to conform to expectations, or do just the opposite—behave in ways they believe will contradict the researchers' predictions. Suppose a team of researchers is studying parenting behaviors. If participants know that everything they say to their children is being carefully recorded, they may not act in a natural way. Instead of revealing the real focus of their investigation, researchers might lead participants to believe they are studying something else, like the way children learn table manners. That way, they can examine the behavior of interest (parenting behaviors) more naturally.

informed consent Acknowledgment from study participants that they understand what their participation will entail.

debriefing Sharing information with participants after their involvement in a study has ended, including the purpose of the research and any deception used.

It is important to note that no one is or should ever be forced to become a research participant. Involvement is completely voluntary, and participants can drop out at any time. And finally, all experiments on humans and animals must be approved by an **Institutional Review Board (IRB)** to ensure the highest ethical standards.

SHOW WHAT YOU KNOW

- Following a study involving a double-blind procedure with a treatment and a placebo, a researcher met with each participant individually to discuss important information about the study. This is known as:
 - informed consent.
 - debriefing.
 - deception.
 - naturalistic observation.
- Before conducting a study, researchers must seek approval from a(n) _____, to ensure the highest ethical standards are upheld.
- What safeguards are in place to protect research participants from harm?

✓ CHECK YOUR ANSWERS IN APPENDIX C.



Sister Love

Sam and Anaïs on their trip to South Korea, where they attended a conference of the International Korean Adoptee Associations. Now that the twins have found each other, they want to help others. Sam and fellow actress Jenna Ushkowitz (also a Korean adoptee) founded Kindred, a nonprofit foundation that provides support and resources for adoptees and their families (Kindred, n.d.). Anaïs, now a designer for the fine leather company Jean Rousseau, hopes to create an educational foundation for orphans and adopted children in Korea, Cambodia, or other countries.

Twinsters (2015) Small Package Films.

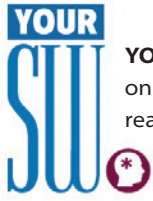
Institutional Review Board (IRB) A committee that reviews research proposals to protect the rights and welfare of all participants.

"ANYTHING IS POSSIBLE" The momentous meeting of Sam and Anaïs marked the beginning of a new journey for the twins and their families. Sam's parents embraced Anaïs as a second daughter, and Anaïs' parents did the same with Sam. After spending time together in London, the families continued getting to know each other through e-mail and text messaging. Anaïs and her parents celebrated Thanksgiving with Sam's family in New Jersey, and the twins celebrated their 26th birthday with Anaïs' parents in France. As Anaïs says, "We really see our family as one huge one living in America and one in France."

As for their biological relatives in Korea, Sam and Anaïs have not been able to establish contact. According to the adoption agency, their biological mother denies ever having twins or giving up her children for adoption. As Sam explains, there is a devastating stigma associated with giving birth to a child out of wedlock in South Korea. "The children, as well as the mothers, are basically outcasts, forced from the family and ostracized by family, peers, employers, and anyone who knows their situation" (Bordier et al., 2014, p. 35). Although Sam and Anaïs were deeply saddened by their birth mother's response, they do not harbor resentment. She gave them life, and she gave them each other, and for that they feel tremendous gratitude.

One of the hardest parts about reuniting with a long-lost twin is resuming everyday life without her by your side, says Sam. In the beginning, the twins saw one another every 2–3 months, meeting in places like Paris, Los Angeles, and Seoul, South Korea. After that period, their visits became less frequent, but their lives remain intertwined. "We're constantly texting or video chatting," says Sam. "If anything is going on with either of us, we're always talking." When Sam imagines what life would be like if she never connected with Anaïs, she sees a version of herself that is more self-absorbed. "I would have been so focused on my career, acting, and pushing myself . . . and it would have been all about me," she says. "Now I have this amazing human across the world that I'm always thinking about and always worrying about."

For Anaïs, finding Sam has made her feel complete in a way she never did before. "I definitely was missing something. I don't know if it was from being adopted or from being separated from Sam," says Anaïs. "I feel complete now." When Anaïs looks at Sam, it's almost like observing herself from the outside. She sees a smart, funny, and charismatic young woman. Appreciating Sam's beautiful qualities has given her newfound confidence: "I feel like now anything is possible, thanks to Sam." [↑](#)



YOUR SCIENTIFIC WORLD is an application-based feature appearing in every chapter. In these online activities, you will take on role-playing scenarios that encourage you to think critically and apply your knowledge of psychological science to solve a real-world problem. For example: How do you know what type of research is best? In this chapter's activity, you will take on the role of a research assistant by designing a study and analyzing the data to ensure accurate and ethical results. You can access Your Scientific World activities in LaunchPad. Have fun!



LearningCurve
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Summary of Concepts

LO 1 Describe how psychologists use the scientific method. (p. 27)

Psychologists use the scientific method to produce empirical evidence based on systematic observation or experiments. The scientific method includes five basic steps: develop a question, formulate a hypothesis, collect data, analyze data, and share the findings. A continuing cycle of exploration, the scientific method uses critical thinking at each step in the process and asks new questions along the way.

LO 2 Distinguish between a random sample and a representative sample. (p. 33)

A population includes all members of a group a researcher is interested in exploring. If the population is large, then the researcher will select a subset, called a sample. With a random sample, all members of a population have an equal chance of being selected to participate in a study. Random sampling increases the likelihood of achieving a representative sample, or one that accurately reflects the population of interest.

LO 3 Recognize several forms of descriptive research. (p. 35)

Descriptive research is a type of investigation used to describe and explore a phenomenon. It is especially useful for studying new or unexplored topics, when researchers might not have specific expectations about outcomes. Descriptive research methods include naturalistic observation, case studies, and the survey method.

LO 4 Describe the correlational method and identify its limitations. (p. 39)

The correlational method examines relationships among variables. Variables can be positively correlated (as one variable goes up, the other goes up), negatively correlated (as one variable goes up, the other goes down), or not at all related. While useful for illuminating links between variables and helping researchers make predictions, the correlational method cannot determine cause and effect. Even a very strong correlation between two variables does not indicate a causal link, as a third variable might be influencing both.

LO 5 Explain how the experimental method can establish cause and effect. (p. 43)

The experimental method is a type of research that can uncover cause-and-effect relationships between independent and dependent variables. A well-designed experiment holds everything constant except for the variables being manipulated by the researcher. If the groups of participants differ on the measure of interest, we can say with confidence that the experimental manipulation caused that change.

LO 6 Explain why reliability and validity are important. (p. 48)

High-quality experiments are both reliable and valid. Reliability refers to the consistency of measures used in an experiment. If a measure produces very similar results at different points in time, it has high test-retest reliability. If the results are the same regardless of who takes the measurement or scores the assessment, the measure has high interrater reliability. Validity refers to the accuracy of measures. If an experiment has internal validity, its design allows it to measure what it intends to measure overall. If an experiment has external validity, its findings can be generalized to the population of interest.

LO 7 Define and give examples of descriptive statistics. (p. 51)

Descriptive statistics summarize the information gathered through research. Psychologists may present raw data using tables, graphs, and charts. They may also describe data sets with numbers that express important characteristics: measures of central tendency (mean, median, and mode), measures of variation (range and standard deviation), and measures of position (percentiles).

LO 8 Define and give examples of inferential statistics. (p. 52)

Inferential statistics go beyond simple data presentation. The goals are to generalize findings from studies, make predictions based on relationships among variables, and test hypotheses. We can also use inferential statistics to make

statements about how confident we are in our findings. If statistical significance is established, we can say with relative confidence that the findings of an experiment did not result from chance, but instead were caused by the researchers' manipulations. Statistical significance is not equivalent to practical significance, however; sometimes the results of a study are statistically significant but unimportant in real-world situations.

Key Terms

case study, p. 36
 confounding variable, p. 45
 control group, p. 45
 correlation, p. 39
 correlation coefficient, p. 39
 correlational method, p. 39
 debriefing, p. 57
 dependent variable (DV), p. 45
 descriptive research, p. 35
 descriptive statistics, p. 51
 double-blind study, p. 46
 experiment, p. 27
 experimental group, p. 45

experimental method, p. 43
 experimenter bias, p. 48
 extraneous variable, p. 45
 hypothesis, p. 27
 hypothesis testing, p. 52
 independent variable (IV), p. 45
 inferential statistics, p. 52
 informed consent, p. 57
 Institutional Review Board (IRB), p. 58
 mean, p. 51
 measures of central tendency, p. 51

measures of variation, p. 51
 median, p. 51
 meta-analysis, p. 55
 mode, p. 51
 naturalistic observation, p. 35
 observer bias, p. 36
 operational definitions, p. 29
 placebo, p. 48
 population, p. 33
 random assignment, p. 44
 random sample, p. 33
 range, p. 51

reliability, p. 48
 replicate, p. 31
 representative sample, p. 34
 sample, p. 33
 scientific method, p. 27
 standard deviation, p. 51
 statistics, p. 51
 statistical significance, p. 53
 survey method, p. 37
 theory, p. 29
 third variable, p. 41
 validity, p. 48
 variables, p. 33

Test Prep ARE YOU READY?

- The goal of _____ is to provide empirical evidence or data based on systematic observation or experimentation.
 - operational definitions
 - critical thinking
 - the scientific method
 - a hypothesis
- A psychologist studying identical twins was interested in their leadership qualities and educational backgrounds. These characteristics are generally referred to as:
 - operational definitions.
 - hypotheses.
 - variables.
 - empiricism.
- With a random sample, every member of the population has:
 - no extraneous variables.
 - no confounding variables.
 - an equal chance of having a characteristic in common.
 - an equal chance of being picked to participate.
- A researcher forming a(n) _____ of high school seniors might select participants using a comprehensive database of all seniors in the United States, as all members of the population would have an equal chance of being selected for the study.
 - control group
 - experimental group
 - natural selection
 - random sample
- A researcher interested in learning more about the effect of separating identical twins shortly after birth might use Sam and Anaïs as a(n) _____, which is a type of descriptive research invaluable for studying rare events.
 - experiment
 - case study
 - naturalistic observation
 - correlational study
- Descriptive research is invaluable to psychologists when they are just beginning to study a phenomenon. Some forms of descriptive research can provide information on:
 - cause-and-effect relationships.
 - random assignment.
 - behaviors in natural environments.
 - experimenter bias.
- With a(n) _____ study, neither the researchers nor the participants know who is getting the treatment or who is getting the placebo.
 - double-blind
 - experimental
 - correlational
 - blind
- The _____ variable is what the researcher manipulates, and the _____ variable is the response the researcher measures.
 - confounding; extraneous
 - extraneous; confounding
 - dependent; independent
 - independent; dependent
- Researchers need to consider the consistency of the measures they use to collect data, or in other words their:
 - placebo effect.
 - reliability.
 - random assignment.
 - visual-spatial skills.
- The _____ of an experiment refers to how accurate the data collection methods are.
 - cause-and-effect relationship
 - experimenter bias
 - validity
 - confounding
- Which of the following is NOT an example of descriptive statistics?
 - measures of central tendency
 - measures of position
 - the mean or arithmetic average
 - hypothesis testing

12. _____ allow us to make inferences and determine the probability of certain events occurring.
- a. Inferential statistics
 - b. Descriptive statistics
 - c. Operational definitions
 - d. Theories
13. The less time students spend studying, the lower their grades will be. This is an example of a(n):
- a. positive correlation.
 - b. negative correlation.
 - c. confounding variable.
 - d. extraneous variable.
14. Some researchers have reported a positive relationship between exposure to violence in media and aggressive behavior. However, we cannot assume that exposure to violence causes aggressive behavior because there may be a(n) _____ that explains the changes in these two variables.
- a. third variable
 - b. operational definition
 - c. control group
 - d. debriefing
15. Researchers must make sure that participants understand what their involvement in a study will entail, including possible harm that could result, before collecting data. This is referred to as:
- a. extraneous variables.
 - b. random assignment.
 - c. informed consent.
 - d. debriefing.
16. A researcher is planning to conduct a study on aggression and exposure to media violence. What can she do to ensure the ethical treatment of the children in her study?
17. Find an article in the popular media that presents variables as having cause-and-effect relationships, but is really a correlational study.
18. Describe the strengths and weaknesses of the correlational method.
19. Reread the feature on the SpongeBob study. How does it establish a cause-and-effect relationship between watching the cartoon and changes in cognitive function? If you were to replicate the study, what would you do to change or improve it?
20. A researcher studying the impact of vitamin D on cognitive functioning gives supplements to the experimental group and a placebo to the control group. After 2 months, she tests the participants' cognitive functioning. What types of descriptive and inferential statistics might she use when she reports her findings?



CHECK YOUR ANSWERS IN APPENDIX C.

check style