Unit II

Research Methods: Thinking Critically With Psychological Science

Unit Overview

Students need to leave a course in psychology knowing one important fact: Psychology is a science. Psychologists use the scientific method to investigate phenomena. Some psychologists conduct experiments to see whether one variable causes another. Other psychologists conduct surveys measuring people’s opinions or their reactions to various stimuli. Still others interview people with mental illness or who have experienced trauma to determine better ways to diagnose and treat disorders. Using these methods helps psychologists describe, explain, and predict behavior better.

Unit II focuses on the different methods psychologists use as they scientifically explore behavior and mental processes. After learning about the methods in this unit, students will be able to:

- Explain how scientifically derived answers are more valid than those derived from intuition or common sense.
- Identify the 3 main components of the scientific attitude and their relation to critical thinking.

Alignment to AP® Course Description

Topic 2: Research Methods (8–10% of AP® Examination)

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 4</td>
<td>Did We Know It All Along? Hindsight Bias</td>
<td>• How can the scientific method help us draw more informed conclusions?</td>
</tr>
<tr>
<td></td>
<td>Overconfidence</td>
<td>• In what ways is our confidence in our predictions often wrong?</td>
</tr>
<tr>
<td></td>
<td>Perceiving Order in Random Events</td>
<td>• Why is it important to understand how randomness works?</td>
</tr>
</tbody>
</table>
| | The Scientific Attitude: Curious, Skeptical, and Humble | • Why is curiosity important to a psychologist?  
• Why is skepticism important to a psychologist?  
• Why is humility important to a psychologist? |
| | Critical Thinking | • Why is critical thinking important to science?  
• What value does critical thinking provide to the scientific process? |
| Module 5 | The Scientific Method | • How does the popular conception of a “theory” differ from the scientific use of the term?  
• Why are operational definitions important to the scientific process?  
• Why is replication such an important function of science? |
| | Description | • How can a descriptive research method advance knowledge of a behavior or mental process? |
| Module 6 | Correlation | • What is the value of knowing that 2 variables are related?  
• Why is correlation not the same as causation? |
<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Essential Questions</th>
</tr>
</thead>
</table>
| Module 6     | Experimentation   | • Why is it important to know how 2 variables influence each other?  
• Why is randomness important to experimentation?  
• Why is it important to control variables in an experiment? |
| (cont.)      |                   |                                                                                     |
| Module 7     | The Need for Statistics | • How can knowing about statistics help you make more informed decisions?            |
|              | Descriptive Statistics | • How does knowledge of the properties of the normal curve and central tendency help you make more informed decisions?  
• What are the limits of descriptive statistics? |
|              | Inferential Statistics | • Why is it important to know that a difference between variables is significant?  
• Why should a sample represent the population? |
| Module 8     | Psychology Applied | • What can psychological science tell us about everyday life?                        |
|              | Ethics in Research | • Should all psychology studies be conducted ethically?  
• Why does following ethical procedures matter? |

**Unit Resources**

**Module 4**

**STUDENT ACTIVITIES**
- Fact or Falsehood?
- The Hindsight Bias and Predicting Research Outcomes
- The Confirmation Bias
- The Overconfidence Phenomenon
- The Gambler's Fallacy

**TEACHER DEMONSTRATIONS**
- The Value of Empirical Investigation
- A Psychic Reading
- Astrology and the Scientific Method

**Module 5**

**STUDENT ACTIVITIES**
- Fact or Falsehood?
- Naturalistic Observation in the Cafeteria
- The Wording of Survey Questions
- Choosing a Random Sample

**FLIP IT VIDEO**
- Operational Definitions

**Module 6**

**STUDENT ACTIVITIES**
- Fact or Falsehood?

**Module 7**

**STUDENT ACTIVITIES**
- Fact or Falsehood?
- Teaching Statistical Concepts Using Space and Students' Bodies
- An M&M's Sampling Demonstration
- When Is a Difference Significant?

**FLIP IT VIDEO**
- The Normal Curve

**Module 8**

**STUDENT ACTIVITIES**
- Fact or Falsehood?
- Animal Care and Use Committee

**FLIP IT VIDEO**
- Ethics
In a difficult moment—after an argument with a loved one, a social embarrassment, or a bad grade—to whom do you turn? For advice and comfort, we often turn to friends and family, or search online. Psychology can also shed insight. Psychologists start with the questions that intrigue all of us: How can we be happier, healthier, and more successful? What can we do to improve our relationships? Why do people act and think as they do? But psychological science takes it a step further and uses careful research to separate uninformed opinions from examined conclusions.
Module 4

The Need for Psychological Science

Module Learning Objectives

4-1 Describe how hindsight bias, overconfidence, and the tendency to perceive order in random events illustrate why science-based answers are more valid than those based on intuition and common sense.

4-2 Identify how the three main components of the scientific attitude relate to critical thinking.

How do hindsight bias, overconfidence, and the tendency to perceive order in random events illustrate why science-based answers are more valid than those based on intuition and common sense?

Some people suppose that psychology merely documents and dresses in jargon what people already know. "So what else is new—you get paid for using fancy methods to prove what everyone knows?" Others place their faith in human intuition. "Buried deep within each and every one of us, there is an instinctive, heart-felt awareness that provides—if we allow it to—the most reliable guide," offered Prince Charles (2000).

One feature of human intuition is its intuitive managing, "intuitive trading," and "intuitive healing." Today's psychological science does document a vast intuitive mind. As we will see, our thinking, memory, and attitudes operate on two levels—conscious and unconscious—with the larger part operating deep within each and every one of us. The limits of intuition. Personal interviews tend to be overconfident of their gut feelings about job applicants. Their confidence stems partly from their recalling cases where their favorable impression proved right, and partly from their ignorance about rejected applicants who succeeded elsewhere.

The first principle is that to today's psychological intuition's perils. My geographical intuition tells me that Reno is east of Los Angeles, that Rome is south of New York, that Atlanta is east of Detroit. But I am wrong, wrong, and wrong. So, are we smart to listen to the whispers of our inner wisdom, to simply trust "the force within"? Or should we more often be subjecting our intuitive hunches to skeptical scrutiny? This much seems certain: We often underestimate intuition's perils. My geographical intuition tells me that Reno is east of Los Angeles, that Rome is south of New York, that Atlanta is east of Detroit. But I am wrong, wrong, and wrong. Modules to come will show that experiments have found people greatly overestimating their lie detection accuracy, their eyewitness recollections, their interviewer assessments, their risk predictions, and their stock-picking talents. As a Nobel Prize-winning physicist explained, "The first principle is that you must not fool yourself—and you are the easiest person to fool" (Feynman, 1997).

How do hindsight bias, overconfidence, and the tendency to perceive order in random events illustrate why science-based answers are more valid than those based on intuition and common sense?
Indeed, observed novelist Madeleine L’Engle, “The naked intellect is an extraordinarily inaccurate instrument” (1973). Three phenomena—hindsight bias, judgmental overconfidence, and our tendency to perceive patterns in random events—illustrate why we cannot rely solely on intuition and common sense.

Did We Know It All Along? Hindsight Bias

Consider how easy it is to draw the bull’s eye after the arrow strikes. After the stock market drops, people say it was “due for a correction.” After the football game, we credit the coach if a “gutsy play” wins the game, and fault the coach for the “stupid play” if it doesn’t. After a war or an election, its outcome usually seems obvious. Although history may therefore seem like a series of inevitable events, the actual future is seldom foreseen. No one’s diary...
TEACH

TRM Concept Connections

Note that the term confirmation bias is not used in this unit, though it is a key term in Unit VII. Table 4.1 provides a great opportunity to discuss confirmation bias, a phenomenon in which people look for evidence that confirms their beliefs and ignore evidence that disputes their beliefs. In addition, you can point out how Myers has highlighted where in the book these topics are discussed further. This shows students that topics in psychology are interrelated. Research methods will be discussed throughout the book, and students should transfer their knowledge in this unit to later units to help them be successful on the AP® exam. As you teach this unit, you can use findings such as these to spur interest in the course and help students see how interconnected psychological content is.

Use Student Activity: The Confirmation Bias from the TRM to help students experience first-hand the issues with confirmation bias.

AP® Exam Tip
It is quite common for multiple-choice questions on the AP® exam to test your knowledge of “media myths.” Pay particular attention when psychological findings run counter to “common sense.”

ENGAGE

TRM Active Learning

This unit provides one of the best opportunities for teaching critical thinking. Have students predict what grade they will get on their next quiz or test. Have them also rate, on a scale of 1–10, how confident they are that their prediction will be correct. Then, after the quiz or test, have students compare their original predictions with their actual scores. How many students fell victim to hindsight bias?

Use Student Activity: The Overconfidence Phenomenon from the TRM to further demonstrate the problem with overconfidence.

Table 4.1 True or False?

Psychological research discussed in modules to come will either confirm or refute each of these statements (adapted, in part, from Furnham et al., 2003). Can you predict which of these popular ideas have been confirmed and which refuted? (Check your answers at the bottom of this table.)

1. If you want to teach a habit that persists, reward the desired behavior every time, not just intermittently (see Module 27).
2. Patients whose brains are surgically split down the middle survive and function much as they did before the surgery (see Module 13).
3. Traumatic experiences, such as sexual abuse or surviving the Holocaust, are typically “repressed” from memory (see Module 33).
4. Most abused children do not become abusive adults (see Module 50).
5. Most infants recognize their own reflection in a mirror by the end of their first year (see Module 47).
6. Adopted siblings usually do not develop similar personalities, even though they are reared by the same parents (see Module 14).
7. Fears of harmless objects, such as flowers, are just as easy to acquire as fears of potentially dangerous objects, such as snakes (see Module 15).
8. Lie detection tests often lie (see Module 41).
9. The brain remains active during sleep (see Modules 22–23).


Surprising if many of psychology’s findings had not been foreseen. Many people believe that love breeds happiness, and they are right (we have what Module 40 calls a deep “need to belong”). Indeed, note Daniel Gilbert, Brett Pelham, and Douglas Krull (2003), “good ideas in psychology usually have an oddly familiar quality, and the moment we encounter them we feel certain that we once came close to thinking the same thing ourselves and simply failed to write it down.” Good ideas are like good inventions; once created, they seem obvious. Why did it take so long for someone to invent suitcases on wheels and Post-it Notes?

But sometimes our intuition, informed by countless casual observations, has it wrong. In later modules we will see how research has overturned popular ideas—that familiarity breeds contempt, that dreams predict the future, and that most of us use only 10 percent of our brain. (See also Table 4.1.) We will also see how it has surprised us with discoveries about how the brain's chemical messengers control our moods and memories, about other animals’ abilities, and about the effects of stress on our capacity to fight disease.

Overconfidence

We humans tend to think we know more than we do. Asked how sure we are of our answers to factual questions (Is Boston north or south of Paris?), we tend to be more confident than correct.1 Or consider these three anagrams, which Richard Goranson (1978) asked people to unscramble:

WREAT → WATER
ENTRY → ETRYN
BARGE → GRABE

"Good ideas are like good inventions; once created, they seem obvious."
About how many seconds do you think it would have taken you to unscramble each of these? Did hindsight influence you? Knowing the answers tends to make us overconfident—surely the solution would take only 10 seconds or so, when in reality the average problem solver spends 3 minutes, as you also might, given a similar anagram without the solution: CHAOS.

Are we any better at predicting social behavior? University of Pennsylvania psychologist Philip Tetlock (1998, 2005) collected more than 27,000 expert predictions of world events, such as the future of South Africa or whether Quebec would separate from Canada. His repeated finding: These predictions, which experts made with 80 percent confidence on average, were right less than 40 percent of the time. Nevertheless, even those who erred maintained their confidence by noting they were “almost right.” “The Québecois separatists almost won the secessionist referendum.”

Perceiving Order in Random Events

In our natural eagerness to make sense of our world—what poet Wallace Stevens called our “rage for order”—we are prone to perceive patterns. People see a face on the moon, hear Satanic messages in music, perceive the Virgin Mary’s image on a grilled cheese sandwich. Even in random data we often find order, because—here’s a curious fact of life—we are prone to perceive patterns. People see a face on the moon, hear Satanic messages in music, perceive the Virgin Mary’s image on a grilled cheese sandwich.

Even in random data we often find order, because—here’s a curious fact of life—we are prone to perceive patterns. People see a face on the moon, hear Satanic messages in music, perceive the Virgin Mary’s image on a grilled cheese sandwich.

Philip Tetlock (1998, 2005) collected more than 27,000 expert predictions of world events, such as the future of South Africa or whether Quebec would separate from Canada. His repeated finding: These predictions, which experts made with 80 percent confidence on average, were right less than 40 percent of the time. Nevertheless, even those who erred maintained their confidence by noting they were “almost right.” “The Québecois separatists almost won the secessionist referendum.”

Perceiving Order in Random Events

In our natural eagerness to make sense of our world—what poet Wallace Stevens called our “rage for order”—we are prone to perceive patterns. People see a face on the moon, hear Satanic messages in music, perceive the Virgin Mary’s image on a grilled cheese sandwich. Even in random data we often find order, because—here’s a curious fact of life—we are prone to perceive patterns. People see a face on the moon, hear Satanic messages in music, perceive the Virgin Mary’s image on a grilled cheese sandwich.

Even in random data we often find order, because—here’s a curious fact of life—we are prone to perceive patterns. People see a face on the moon, hear Satanic messages in music, perceive the Virgin Mary’s image on a grilled cheese sandwich.

Daniel Kahneman and Amos Tversky (1972) found that most people believe HTTHTH would be the most likely random sequence. Actually, all three are equally likely (or, you might say, equally unlikely). A poker hand of 10 through ace, all of hearts, would seem extraordinary; actually, it would be no more or less likely than any other specific hand of cards (FIGURE 4.1).

In actual random sequences, patterns and streaks (such as repeating digits) occur more often than people expect (Oskarsson et al., 2009). To demonstrate this phenomenon for myself, I flipped a coin 51 times, with these results:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H</td>
<td>T</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>T</td>
<td>T</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>T</td>
<td>H</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>T</td>
<td>13</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>5</td>
<td>H</td>
<td>T</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>H</td>
<td>15</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td>7</td>
<td>H</td>
<td>16</td>
<td>25</td>
<td>34</td>
</tr>
<tr>
<td>8</td>
<td>T</td>
<td>17</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>T</td>
<td>18</td>
<td>27</td>
<td>36</td>
</tr>
</tbody>
</table>

Looking over the sequence, patterns jump out: Tosses 10 to 22 provided an almost perfect pattern of pairs of tails followed by pairs of heads. On tosses 30 to 38 I had a “cold hand,” with only one head in nine tosses. But my fortunes immediately reversed with a “hot hand”—seven heads out of the next nine tosses. Similar streaks happen, about as often as one would expect in random sequences, in basketball shooting, baseball hitting, and mutual fund stock pickers’ selections (Gilovich et al., 1985; Malkiel, 2007; Myers, 2002). These sequences often don’t look random and so are overinterpreted. (“When you’re hot, you’re hot!”)

Overconfidence in history:

We don’t like their sound. Groups of guitars are on their way out. —George Harrison, in turning down a recording contract with the Beatles in 1962

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

They couldn’t hit an elephant at this distance. —General John Pershing, just before being killed—literally—a U.S. Col. WWI satin, 1944

“The telephone may be appropriate for our American cousins, but not here, because we have an adequate supply of messenger boys.” —British agent sent to evaluate the invention of the telephone

The Need for Psychological Science

Active Learning

Perhaps the simplest demonstration of overconfidence is to have students predict their score on a multiple-choice or another type of short-answer test, such as the Fact or Falsehood? activity that accompanies each unit, immediately after they have completed it (have them note their estimate at the top of the test). The majority will overestimate the number of questions they get right. You could use this procedure for every test you give, helping students become better at predicting their own performance.

ENGAGE

TRM Applying Science

Have students do their own coin flip research. Students can replicate the 51 coin flips Myers conducted for this module to see what patterns might emerge. They could also expand the research to see if different patterns emerge using different types of coins.

Use Student Activity: The Gambler’s Fallacy from the TRM to help demonstrate random sequences using coin flips.

1 Boston is south of Paris.
2 The anagram solution: CHAOS.
Online Activities
The Winton Programme for the Public Understanding of Risk based in the Statistical Laboratory in the University of Cambridge runs a website that collects stories about coincidences. The group lists 5 common types of coincidence and examples of each one:

- **Surprising repetitions**: multiple members of the same family who are born with the same birthday
- **Simultaneous events**: 2 people who phone each other exactly at the same time
- **Parallel lives**: 2 people in a small group who share a birthday or an unusual name
- **Uncanny patterns**: picking letters in Scrabble that spell your name
- **Unlikely chains of events**: losing false teeth overboard and finding them inside a fish you caught 20 years later

Use this website to collect more examples of coincidences, and help explain to students the mathematics of probability: www.understandinguncertainty.org.

Active Learning
Testing magic tricks is a good way for students to see the scientific method in action. Consider performing some simple magic or card tricks in class and have students use the scientific method to test the "magic" of the trick. Students can also research some famous magicians or magicians' tricks to see how controlling variables and exhibiting healthy skepticism are important to scientific thinking.

--

ENGAGE

Online Activities

The magician James Randi exemplifies skepticism. He has tested and debunked supposed psychic phenomena. The Amazing Randi: The magician James Randi exemplifies skepticism. He has tested and debunked supposed psychic phenomena.

TRM Online Activities

James Randi, also known as The Amazing Magicians or Magicians' Tricks in Class in Action. Consider performing some simple magic or card tricks in class to see the scientific method in action. Testing magic tricks is a good way for students to see the scientific method in action. Consider performing some simple magic or card tricks in class and have students use the scientific method to test the "magic" of the trick. Students can also research some famous magicians or magicians' tricks to see how controlling variables and exhibiting healthy skepticism are important to scientific thinking.

What explains these streaky patterns? Was I exercising some sort of paranormal control over my coin? Did I snap out of my tailed funk and get in a heels groove? No such explanations are needed, for these are the sorts of streaks found in any random data. Comparing each toss to the next, 23 of the 50 comparisons yielded a changed result—just the sort of near 50-50 result we expect from coin tossing. Despite seeming patterns, the outcome of one toss gives no due to the outcome of the next.

However, some happenings seem so extraordinary that we struggle to conceive an ordinary, chance-related explanation (as applies to our coin tosses). In such cases, statisticians often are more mystified. When Evelyn Marie Adams won the New Jersey lottery twice, newspapers reported the odds of her feat as 1 in 17 trillion. Bizarre? Actually, 1 in 17 trillion are indeed the odds that a given person who buys a single ticket for two New Jersey lotteries will win both times. And given the millions of people who buy U.S. state lottery tickets, statisticians Stephen Samuels and George McCabe (1989) reported it was "practically a sure thing" that someday, somewhere, someone would hit a state jackpot twice. Indeed, said fellow statisticians Persi Diaconis and Frederick Mosteller (1989), "with a large enough sample, any outrageous thing is likely to happen." An event that happens to but 1 in 1 billion people every day occurs about 7 times a day, 2500 times a year.

The point to remember: Hindsight bias, overconfidence, and our tendency to perceive patterns in random events often lead us to overestimate our intuition. But scientific inquiry can help us sift reality from illusion.

The Scientific Attitude: Curious, Skeptical, and Humble

How do the scientific attitude’s three main components relate to critical thinking?

Underlying all science is, first, a hard-headed curiosity, a passion to explore and understand without misleading or being misled. Some questions (Is there life after death?) are beyond science. Answering them in any way requires a leap of faith. With many other ideas (Can some people demonstrate ESP?) the proof is in the pudding. Let the facts speak for themselves. Magician James Randi has used this empirical approach when testing those claiming to see auras around people's bodies.

Randi: Do you see an aura around my head?
Aura-seer: Yes, indeed.
Randi: Can you still see the aura if I put this magazine in front of my face?
Aura-seer: Of course.
Randi: Then if I were to step behind a wall barely taller than I am, you could determine my location from the aura visible above my head, right?
Randi: told me that no aura-seer has agreed to take this simple test.

No matter how sensible-seeming or wild an idea, the smart thinker asks: Does it work? When put to the test, can its predictions be confirmed? Subjected to such scrutiny, crazy-sounding ideas sometimes find support. During the 1700s, scientists scoffed at the notion that meteorites had extraterrestrial origins. When two Yale scientists challenged the conventional opinion, Thomas Jefferson jeered, "Gentlemen, I would rather believe that those two Yankee professors would be than to believe that stones fell from Heaven." Sometimes scientific inquiry turns fers into cheers. More often, science becomes society's garbage disposal, sending crazy-sounding ideas to the waste heap, atop previous claims of perpetual motion machines, miracle cancer cures, and out-of-body travels into centuries past. To sift reality from fantasy, sense from nonsense, therefore requires a scientific attitude—being skeptical but not cynical, open but not gullible.
The Need for Psychological Science

Module 4

35

Critical Thinking

The scientific attitude prepares us to think smarter. Smart thinking, called critical thinking, examines assumptions, assesses the source, discerns hidden values, confirms evidence, and assesses conclusions. Whether reading a news report or listening to a conversation, critical thinkers ask questions. Like scientists, they wonder: How do they know that? What is this person’s agenda? Is the conclusion based on anecdote and gut feelings, or on evidence? Does the evidence justify a cause-effect conclusion? What alternative explanations are possible?

Critical thinking, informed by science, helps clear the colored lenses of our biases. Consider: Does climate change threaten our future, and, if so, is it human-caused? In 2009, climate-action advocates interpreted an Australian heat wave and dust storms as evidence of climate change. In 2010, climate-change skeptics perceived North American bitter cold and East Coast blizzards as discounting global warming. Rather than having their understanding persistently determined by their own agenda, critical thinkers ask questions. Like scientists, they wonder: How do they know that? What is this person’s agenda? Is the conclusion based on anecdote and gut feelings, or on evidence? Does the evidence justify a cause-effect conclusion? What alternative explanations are possible?

Critical thinking helps students develop the skills that they need as they become contributing members of society. It prepares them to think smarter and to avoid making bad judgments. Critical thinking can also help students achieve academic success. Psychologists who teach critical thinking to students report that students who think critically are more motivated to learn and to do well in school. In addition, students who think critically can achieve high grades without sacrificing their health, happiness, or any other important goals in life.

Critical Thinking in Psychological Science

Critical thinking is the heart and soul of psychological science. It is the single most important characteristic that sets psychologists apart from other scientific communities. Psychologists approach the world of behavior with a curious, skeptical, and humble attitude. This attitude prepares them to think smarter. They are alert to the evidence that is relevant to their questions. They are comfortable with controversy. They are willing to reassess their conclusions as new evidence becomes available. They are willing to make their ideas public for others to critique. They are willing to make their ideas public for others to critique. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it.

Of course, scientists, like anyone else, can have big egos and may cling to their preconceptions. Nevertheless, the ideal of curious, skeptical, humble scrutiny of competing ideas unifies psychologists as a community as they check and recheck one another’s findings and conclusions.

Critical Thinking

The scientific attitude prepares us to think smarter. Smart thinking, called critical thinking, examines assumptions, assesses the source, discerns hidden values, confirms evidence, and assesses conclusions. Whether reading a news report or listening to a conversation, critical thinkers ask questions. Like scientists, they wonder: How do they know that? What is this person’s agenda? Is the conclusion based on anecdote and gut feelings, or on evidence? Does the evidence justify a cause-effect conclusion? What alternative explanations are possible?

Critical thinking helps students develop the skills that they need as they become contributing members of society. It prepares them to think smarter and to avoid making bad judgments. Critical thinking can also help students achieve academic success. Psychologists who teach critical thinking to students report that students who think critically are more motivated to learn and to do well in school. In addition, students who think critically can achieve high grades without sacrificing their health, happiness, or any other important goals in life.

Critical Thinking in Psychological Science

Critical thinking is the heart and soul of psychological science. It is the single most important characteristic that sets psychologists apart from other scientific communities. Psychologists approach the world of behavior with a curious, skeptical, and humble attitude. This attitude prepares them to think smarter. They are alert to the evidence that is relevant to their questions. They are comfortable with controversy. They are willing to reassess their conclusions as new evidence becomes available. They are willing to make their ideas public for others to critique. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it.

Of course, scientists, like anyone else, can have big egos and may cling to their preconceptions. Nevertheless, the ideal of curious, skeptical, humble scrutiny of competing ideas unifies psychologists as a community as they check and recheck one another’s findings and conclusions.

Critical Thinking

The scientific attitude prepares us to think smarter. Smart thinking, called critical thinking, examines assumptions, assesses the source, discerns hidden values, confirms evidence, and assesses conclusions. Whether reading a news report or listening to a conversation, critical thinkers ask questions. Like scientists, they wonder: How do they know that? What is this person’s agenda? Is the conclusion based on anecdote and gut feelings, or on evidence? Does the evidence justify a cause-effect conclusion? What alternative explanations are possible?

Critical thinking helps students develop the skills that they need as they become contributing members of society. It prepares them to think smarter and to avoid making bad judgments. Critical thinking can also help students achieve academic success. Psychologists who teach critical thinking to students report that students who think critically are more motivated to learn and to do well in school. In addition, students who think critically can achieve high grades without sacrificing their health, happiness, or any other important goals in life.

Critical Thinking in Psychological Science

Critical thinking is the heart and soul of psychological science. It is the single most important characteristic that sets psychologists apart from other scientific communities. Psychologists approach the world of behavior with a curious, skeptical, and humble attitude. This attitude prepares them to think smarter. They are alert to the evidence that is relevant to their questions. They are comfortable with controversy. They are willing to reassess their conclusions as new evidence becomes available. They are willing to make their ideas public for others to critique. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it. They are willing to change their minds when new evidence warrants it.

Of course, scientists, like anyone else, can have big egos and may cling to their preconceptions. Nevertheless, the ideal of curious, skeptical, humble scrutiny of competing ideas unifies psychologists as a community as they check and recheck one another’s findings and conclusions.
Help students explore their own critical thinking with these demonstrations from chemistry and physics. You may consider partnering with a chemistry or physics teacher to present and explain these demonstrations:

- Fill a glass completely with water, and place it on your desk or lectern. Ask students what will happen if you slip a penny into the glass. Many will say that the glass will overflow. Slip the penny in to demonstrate. Have students speculate how many pennies it will take to cause the water to overflow. Begin slipping in pennies. You will be able to drop dozens in a medium-sized glass. Counter to human intuition, water has a high surface tension, behavior as though it has a flexible skin. That skin pulls inward and resists breaking. The glass of water will develop a great bulge before the water flows over the edge.

- In Uncommon Sense: The Heretical Nature of Science, physicist Alan Cromer gives many examples of how our intuition is often wrong when it comes to physical reality. You might present some of Cromer’s examples in class.
  
  - If you drop a bullet off a table 3 feet high, and fire another one straight across an empty football field, which hits the ground first? Although intuition tells us that the dropped bullet lands first because it has only 3 feet to travel, in reality both bullets hit at the same time because downward velocity is independent of horizontal velocity.
  
  - A ball rolls down a spiral track. The end of the track curves left. What path does the ball take when it leaves the track? Although intuition suggests that it curves, because an object continues to move in the same direction, the correct answer is that it follows a straight line to the left. Only objects acted on by a constant lateral force curve.
  
  - A wooden cube is 1 inch long on each side. How many cubes form a cube 2 inches along each side? Intuition says 2, because a 2-inch cube is twice as big as a 1-inch cube. The solution is actually 8. Two cubes make a tower. For a cube, you need 2 layers of 4.

---

*The real purpose of the scientific method is to make sure Nature hasn’t made you into thinking you know something you don’t actually know.* —Roger M. Pines, Zen and the Art of Mentalistic Movements, 1974

---

**Before You Move On**

**ASK YOURSELF**

How might critical thinking help us assess someone’s interpretations of people’s dreams or their claims to communicate with the dead?

**TEST YOURSELF**

How does the scientific attitude contribute to critical thinking?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

---

**Module 4 Review**

**4-1** How do hindsight bias, overconfidence, and the tendency to perceive order in random events illustrate why science-based answers are more valid than those based on intuition and common sense?

- **Hindsight bias** (also called the “I-knew-it-all-along phenomenon”) is the tendency to believe, after learning an outcome, that we would have foreseen it.

- **Overconfidence** in our judgments results partly from our bias to seek information that confirms them.

- These tendencies, plus our eagerness to perceive patterns in random events, lead us to overestimate our intuition.

**4-2** How do the scientific attitude’s three main components relate to critical thinking?

- The scientific attitude equips us to be curious, skeptical, and humble in scrutinizing competing ideas or our own observations.

- This attitude carries into everyday life as critical thinking, which puts ideas to the test by examining assumptions, assessing the source, discerning hidden values, evaluating evidence, and assessing conclusions.

---


Although it is important for students to learn the material in this book for the AP® exam, they should also leave this course with the ability to apply the scientific method and mind-set to psychological research findings. The media report on psychological research daily, and students need to be able to apply their knowledge of sound research learned in this course to these reports. Being able to think critically about psychological science is an important skill students can gain from taking AP® Psychology.

**Teach**

**Teaching Tip**

The Need for Psychological Science  Module 4  37

**CLOSE & ASSESS**

**Exit Assessment**

Have students identify from memory the 3 main components of the scientific attitude and explain why they are important for scientists.

**Answers to Multiple-Choice Questions**

1. c  3. b  
2. c  4. d

**Practice FRQs**

1. Name the three components of the scientific attitude. Provide an example to show how each component contributes to the investigation of competing ideas in psychology.

   **Answer**

   1 point: Curiosity, or passion to explore, leads us to questions we want to investigate. Any examples of such questions will serve (For example, Does more money make us happier? Is schizophrenia inherited?).

   1 point: Skepticism keeps us from accepting ideas without sound support. The work of The Amazing Randi would be a good example here.

   1 point: Humility keeps us open to the possibility of changing our ideas when they are not supported by the data. For example, "the rat is always right."

2. Aziz has read that handwriting reveals important details about personality. Explain how each component of the scientific attitude can help Aziz investigate the accuracy of the information he has read about handwriting analysis.

   **Answer**

   1 point: Curiosity involves a willingness to ask questions and seek answers about handwriting analysis.

   1 point: Skepticism will help Aziz critically evaluate the results of his investigation for any potential flaws or alternative explanations.

   1 point: Humility will help Aziz be aware of any potential biases that could cloud his interpretation of the data. Aziz can then rely on the evidence gathered during his research rather than preexisting notions about what "should" happen.
The Scientific Method and Description

Module Learning Objectives

5-1 Describe how theories advance psychological science.

5-2 Describe how psychologists use case studies, naturalistic observation, and surveys to observe and describe behavior, and explain the importance of random sampling.

Psychologists arm their scientific attitude with the scientific method—a self-correcting process for evaluating ideas with observation and analysis. In its attempt to describe and explain human nature, psychological science welcomes hunches and plausible-sounding theories. And it puts them to the test. If a theory works—if the data support its predictions—so much the better for that theory. If the predictions fail, the theory will be revised or rejected.

The Scientific Method

How do theories advance psychological science?

5-1 Describe how theories advance psychological science.

Chatting with friends and family, we often use theory to mean “mere hunch.” In science, a theory explains behaviors or events by offering ideas that organize what we have observed. By organizing isolated facts, a theory simplifies. By linking facts with deeper principles, a theory offers a useful summary. As we connect the observed dots, a coherent picture emerges. A theory about the effects of sleep on memory, for example, helps us organize countless sleep-related observations into a short list of principles. Imagine that we observe over and over that people with good sleep habits tend to answer questions correctly in class, and they do well at test time. We might therefore theorize that sleep improves memory. So far so good: Our principle neatly summarizes a list of facts about the effects of a good night’s sleep on memory.

Yet no matter how reasonable a theory may sound—and it does seem reasonable to suggest that sleep could improve memory—we must put it to the test. A good theory produces testable predictions, called hypotheses. Such predictions specify what results (what behaviors or events) would support the theory and what results would cast doubt on the theory. To test our theory about the effects of sleep on memory, our hypothesis might be that when sleep deprived, people will remember less from the day before. To test that hypothesis, we might assess how well people remember course materials they studied before a good night's sleep, or before a shortened night's sleep. (Figure 5.1). The results will either confirm our theory or lead us to revise or reject it.

5-2 Describe how psychologists use case studies, naturalistic observation, and surveys to observe and describe behavior, and explain the importance of random sampling.

Students can get some additional help understanding operational definitions by watching the Flip It Video: Operational Definitions on this topic. This short, informative video teaches students about the essential elements of an operational definition, guides them through creating one, and reminds students how important operational definitions are to a research design.
Our theories can bias our observations. Having theorized that better memory springs from more sleep, we may see what we expect: We may perceive sleepy people’s comments as less insightful. Perhaps you are aware of students who, because they have developed an excellent reputation, can now do no wrong in the eyes of teachers. If they’re in the hall during class, nobody worries. Other students can do no good, because they have behaved badly in the past, even their positive behaviors are viewed suspiciously.

As a check on their biases, psychologists use operational definitions when they report their studies. “Sleep deprived,” for example, may be defined as “X hours less” than the person’s normal sleep. Unlike dictionary definitions, operational definitions describe concepts with precise procedures or measures. These exact descriptions will allow anyone to replicate (repeat) the research. Other people can then re-create the study with different participants in different situations. If they get similar results, we can be confident that the findings are reliable.

Let’s summarize: A good theory:
- effectively organizes a range of self-reports and observations.
- leads to clear hypotheses (predictions) that anyone can use to check the theory.
- often stimulates research that leads to a revised theory which better organizes and predicts what we know. Or, our research may be replicated and supported by similar findings. (This has been the case for sleep and memory studies, as you will see in Module 24.)

We can test our hypotheses and refine our theories in several ways.
- Descriptive methods describe behaviors, often by using case studies, surveys, or naturalistic observations.
- Correlational methods associate different factors, or variables (you’ll see the word variable often in descriptions of research. It refers to anything that contributes to a result.)
- Experimental methods manipulate variables to discover their effects.

To think critically about popular psychology claims, we need to understand the strengths and weaknesses of these methods.

**TEACH**

**Teaching Tip**

Using Figure 5.1, help students see that the scientific method is a self-sustaining process. Theories lead to hypotheses, which lead to research, which leads to stronger theories, which lead to more hypotheses. The scientific process is a creative process because of the feedback loop. One researcher’s ideas can generate another researcher’s ideas, leading to a more thorough understanding of how the world works.

**TEACH**

**Common Pitfalls**

Operational definitions are often tough for students to understand. The operational definition is perhaps the most important part of the research study, because it defines what the researcher will be observing and manipulating. Students get hung up on the definition of the variable itself, however. They often want the definition to be “correct” or all-encompassing of the concept described. Help students realize that operational definitions need to be (1) measurable and (2) manageable. If they are not measurable and manageable, the research will be difficult to conduct.

**TEACH**

**Teaching Tip**

Replication is the main goal of all good research. Replication allows researchers to test hypotheses with other samples from other populations so that results can be generalized. If results work for many different types of populations, then scientists can be reasonably comfortable that those results would apply to most people. Consider having students read “Is Psychology About to Come Undone?” for more information about this important issue. http://chronicle.com/blogs/percolator/is-psychology-about-to-come-undone/29045.

**ENGAGE**

**Active Learning**

Have students generate operational definitions for the following variables:
- Happiness (i.e., number of smiles a person makes in a period of time)
- A smile (i.e., upturned lips, exposed teeth)
- Intelligence (i.e., score on an IQ test; grades in advanced classes)
- Popularity (i.e., ratings from peer group; number of school elections won)
- Good music (i.e., number of weeks at the top of the charts; number of albums sold)

Students will find it difficult to generate a measurable and manageable definition for each of these variables, so help guide them toward those goals.
Concept Connections

Some of the most famous psychological phenomena are based on case study research.

- Psychoanalysis: Sigmund Freud and Carl Jung developed much of their theories of human personality based on case studies.
- Behaviorism: John Watson and Rosalie Rayner conducted an intensive experiment known as the "Little Albert" study to demonstrate classically conditioned emotions. Little Albert was trained to fear white, furry objects by associating those objects with a loud noise. This experiment is explained in more detail in Unit VI.
- Neuroscience: Paul Broca had a patient who could only utter one syllable: "tan." Upon Tan's death, Broca studied the patient's brain, hypothesizing that the damaged area was where the ability to speak lies. Broca's research is discussed further in Unit III.

Description

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

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

- case studies (analyses of special individuals);
- naturalistic observation (watching and recording the natural behavior of many individuals);
- surveys and interviews (by asking people questions).

The Case Study

Psychologists use the case study, which is among the oldest research methods, to examine one individual or group in depth in the hope of revealing things true of all of us. Some examples: Much of our early knowledge about the brain came from case studies of individuals who suffered a particular impairment after damage to a certain brain region. Jean Paugot taught us about children's thinking through case studies in which he carefully observed and questioned individual children. Studies of only a few chimpanzees have revealed their capacity for understanding and language. Intensive case studies are sometimes very revealing. They show us what can happen, and they often suggest directions for further study.

But individual cases may mislead us if the individual is atypical. Unrepresentative information can lead to mistaken judgments and false conclusions. Indeed, anytime a researcher mentions a finding ("Smokers die younger: ninety-five percent of men over 85 are non-smokers") someone is sure to offer a contradictory anecdote ("Well, I have an uncle who smoked two packs a day and lived to 90"). Dramatic stories and personal experiences (even psychological case examples) command our attention and are easily remembered. Journalists understand that, and so begin an article about bank foreclosures with the sad story of one family put out of their house, not with foreclosure statistics: Stories move us. But stories can mislead. Which of the following do you find more memorable?

(1) "In one study of 1300 dream reports concerning a kidnapped child, only 5 percent correctly envisioned the child as dead." (Murray & Wheeler, 1937).

(2) "I know a man who dreamed his sister was in a car accident, and two days later she died in a head-on collision!" Numbers can be numbing, but the plural of anecdote is not evidence. As psychologist Gordon Allport (1954, p. 9) said, "Given a thoughtful (dramatic) facts we rush to make generalizations as logan as a tub."

The point to remember: Individual cases can suggest fruitful ideas. What's true of all of us can be glimpsed in any one of us. But to discern the general truths that cover individual cases, we must answer questions with other research methods.

Naturalistic Observation

A second descriptive method records behavior in natural environments. These naturalistic observations range from watching chimpanzee societies in the jungle, to unobtrusively observing and recording behavior in naturally occurring situations without trying to manipulate and control the situation.

Interdisciplinary Connections

Some disciplines, such as anthropology, sociology, and zoology, rely heavily on case studies and observational research. Have students contact working researchers in these fields to assess how they use these techniques to increase basic knowledge in their fields. Students may also explore the lives and work of some famous researchers such as primatologists Jane Goodall and Dian Fossey who used observational field research extensively.
Such unobtrusive naturalistic observations paved the way for later studies of animal thinking, language, and emotion, which farther expanded our understanding of our fellow animals. “Observations, made in the natural habitat, helped to show that the societies and behavior of animals are far more complex than previously supposed,” chimpanzee observer Jane Goodall noted (1998). Thanks to researchers’ observations, we know that chimpanzees and baboons use deception. Psychologists Andrew Whiten and Richard Byrne (1988) repeatedly saw one young baboon pretending to have been attacked by another as a tactic to get its mother to drive the other baboon away from its food. The more developed a primate species’ brain, the more likely it is that the animals will display deceptive behaviors (Byrne & Corp, 2004).

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

- **A funny finding.** We humans laugh 30 times more often in social situations than in solitary situations. (Have you noticed how seldom you laugh when alone?) As we laugh, 17 muscles contort our mouth and squeeze our eyes, and we emit a series of 75-millisecond vowel-like sounds, spaced about one-fifth of a second apart (Provine, 2003).
- **Sounding out students.** What, really, are college psychology students saying and doing during their everyday lives? To find out, researchers equipped 52 such students from the University of Texas with electronic recorders (Mehl & Pennebaker, 2003). For up to four days, the recorders captured 30 seconds of the students’ waking hours every 12.5 minutes, thus enabling the researchers to eavesdrop on more than 10,000 half-minute life slices by the end of the study. On what percentage of the slices do you suppose they found the students talking with someone? What percentage captured the students at a computer? The answers: 28 and 9 percent. (What percentage of your waking hours are spent in these activities?)
- **What’s on your mind?** To find out what was on the mind of their University of Nevada, Las Vegas, students, researchers gave them beepers (Heavey & Hurlburt, 2008). On a half-dozen occasions, a beep interrupted students’ daily activities, signaling them to pull out a notebook and record their inner experience at that moment. When the researchers later coded the reports in categories, they found five common forms of inner experience (TABLE 5.1 on the next page).
- **Culture, climate, and the pace of life.** Naturalistic observation also enabled researchers to compare the pace of life in 31 countries (Levine & Norenzayan, 1999). (Their operational definition of pace of life included walking speed, the speed with which postal clerks completed a simple request, and the accuracy of public clocks.) Their conclusion: Life is fastest paced in Japan and Western Europe, and slower paced in economically less-developed countries. People in colder climates also tend to live at a faster pace (and are more prone to die from heart disease).

### Table 5.1

<table>
<thead>
<tr>
<th>Country</th>
<th>Pace of Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Fastest</td>
</tr>
<tr>
<td>Western Europe</td>
<td>Faster</td>
</tr>
<tr>
<td>Less-developed</td>
<td>Slower</td>
</tr>
</tbody>
</table>

> Naturalistic observation also enabled researchers to compare the pace of life in 31 countries (Levine & Norenzayan, 1999). (Their operational definition of pace of life included walking speed, the speed with which postal clerks completed a simple request, and the accuracy of public clocks.) Their conclusion: Life is fastest paced in Japan and Western Europe, and slower paced in economically less-developed countries. People in colder climates also tend to live at a faster pace (and are more prone to die from heart disease).
**ENGAGE**

**Active Learning**
Take a survey of your students, asking them questions about their birthday, shoe size, favorite color, favorite food, favorite soft drink, mother’s first name, etc. Have students find another student in the room who has the most items the same as their own. You may find that you have 2 students who share the same birthday, cola preference, and mother’s name! This seemingly spooky similarity is actually quite predictable.

**ENGAGE**

**Applying Science**
Have students write and distribute a short survey (no more than 5 items). Easy topics for surveys often focus on students’ preferences for music, food, hobbies, or entertainment choices. They can tabulate their results and even run correlations on data that are not categorical, such as Likert (agree–disagree) ratings or class test scores using software programs like Excel or SPSS.

**TEACH**

**TRM** **Teaching Tip**
Provide some useful examples to students about how wording effects can influence survey results:
- One survey found that 77% were interested in plants and trees but only 39% were interested in botany.
- A total of 48% were interested in fossils but only 39% were interested in paleontology.
- Studies have shown that when interviewed by Whites, 62% of White respondents agreed, “The problems faced by Blacks were brought on by Blacks themselves.” When interviewed by Blacks, only 46% agreed.
- When interviewed by a man, 64% of women agreed, “abortion is a private matter that should be left to the woman to decide without government interference.” When interviewed by a woman, 84% of women respondents agreed.
- A Gallup poll found that 91% favored a “waiting period and background check before guns can be sold.” A Wirthlin Poll for the National Rifle Association reported that only 37% favor a “national gun-registration program costing about 20% of all dollars now spent on crime control.”
- In the 1940s, a majority of Americans thought that the United States should “not allow” public speeches against democracy, but only a minority thought we should “forbid” such public speeches. Differences have also been found between “not allowing” and “forbidding” pews shows, X-rated films, and the use of salt to melt snow on highways.
- Naturalistic observation offers interesting snapshots of everyday life, but it does so without controlling for all the variables that may influence behavior. It’s one thing to observe the pace of life in various places, but another to understand what makes some people walk faster than others.

**WORDBED EFFECTS**

As we will see in Module 35, even subtle changes in the order or wording of questions—the way we frame a question—can have major effects. People are much more approving of “not allowing” televised cigarette ads and pornography than of “forbidding” them, and of “revenue enhancers” than of “taxes.” In 2009, three in four Americans in one national survey approved of giving people “a choice” of public, government-run, or private health insurance. Yet in another survey, most Americans were not in favor of “creating a public health-care plan administered by the federal government that would compete directly with private health insurance companies” (Stein, 2009). Because wording is such a delicate matter, critical thinkers will reflect on how the phrasing of a question might affect people’s expressed opinions.

---

**Table 5.1 A Penny for Their Thoughts: The Inner Experience of University Students**

<table>
<thead>
<tr>
<th>Inner Experience</th>
<th>Example</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner speech</td>
<td>Susan was saying to herself, “I’ve got to get to class.”</td>
<td>26%</td>
</tr>
<tr>
<td>Inner seeing</td>
<td>Paul was imagining the face of a best friend, including her neck and head.</td>
<td>34%</td>
</tr>
<tr>
<td>Unsolicited</td>
<td>Alphonse was wondering whether the workers would drop the bricks.</td>
<td>22%</td>
</tr>
<tr>
<td>Feeling</td>
<td>Courtney was experiencing anger and its physical symptoms.</td>
<td>26%</td>
</tr>
<tr>
<td>Sensory awareness</td>
<td>Fiona was feeling the cold breeze on her cheek and her hair moving.</td>
<td>22%</td>
</tr>
</tbody>
</table>

*More than one experience could occur at once.*

---

Use Student Activity: The Wording of Survey Questions from the TRM to explore this issue further.
RANDOM SAMPLING
In everyday thinking, we tend to generalize from samples we observe, especially vivid cases. Given (a) a statistical summary of auto owners’ evaluations of their car make and (b) the vivid comments of a biased sample—two frustrated owners—our impression may be influenced as much by the two unhappy owners as by the many more evaluations in the statistical summary. The temptation to ignore the sampling bias and to generalize from a few vivid but unrepresentative cases is nearly irresistible.

The point to remember: The best basis for generalizing is from a representative sample. But it’s not always possible to survey everyone in a group. So how do you obtain a representative sample—say, of the students at your high school? How could you choose a group that would represent the total student population, the whole group you want to study and describe? Typically, you would seek a random sample, in which every person in the entire group has an equal chance of participating. You might number the names in the general student list and then use a random number generator to pick your survey participants. (Sending each student a questionnaire wouldn’t work because the conscientious people who returned it would not be a random sample.) Large representative samples are better than small ones, but a small representative sample of 100 is better than an unrepresentative sample of 500.

Political pollsters sample voters in national election surveys just this way. Using only 1500 randomly sampled people, drawn from all areas of a country, they can provide a remarkably accurate snapshot of the nation’s opinions. Without random sampling (also called random selection), large samples—including call-in phone samples and TV or website polls (think of American Idol fans voting)—often merely give misleading results. The point to remember: Before accepting survey findings, think critically. Consider the sample. You cannot compensate for an unrepresentative sample by simply adding more people.

Before You Move On

ASK YOURSELF
Can you recall examples of misleading surveys you have experienced or read about? What survey principles did they violate?

TEST YOURSELF
What are some strengths and weaknesses of the three different methods psychologists use to describe behavior—case studies, naturalistic observation, and surveys?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

ENGAGE

Critical Questions
To evaluate research your class may examine throughout the course, have students discuss whether the samples generated are also representative. Representative samples represent the population, and students can see if the sample generated represents the population from which it came. Do the percentages of males and females match between sample and population? Do percentages of racial/ethnic identity match? Other demographics?

FYI
With very large samples, estimates become quite reliable. If a is estimated to represent 12.7 percent of the letters in written English, E, in fact, is 12.3 percent of the 295,141 letters in Melville’s Moby Dick, 12.4 percent of the 586,747 letters in Dickens’ A Tale of Two Cities, and 12.1 percent of the 3,801,021 letters in 12 of Mark Twain’s works (Chance Hewitt, 1987).

TRM
Active Learning
Generate random samples from a population—your class. This demonstration helps students see that there are several ways to generate a random sample.

● Acquire a random number table, perhaps from a math textbook (these are also easy to find on the Internet if you search for “random number table”). Choose a number on the list at random, and use the last 2 digits of the number to choose 5–10 students from your class roll.

● Take a coin and flip it as you come to each student in the room. Choose heads for participants and tails for nonparticipants.

● Put all the students’ names into a hat. Draw out half the names for your participants.

Use Student Activity: Choosing a Random Sample from the TRM to help students understand random sampling.

TEACH
Concept Connections
A random sample typically generates a representative sample. These 2 terms are similar and often refer to the same group of participants in a research study. Help students see how these 2 terms are related.
Answers to Multiple-Choice Questions

1. a 4. b 7. a
2. d 5. c
3. e 6. d

Module 5 Review

How do theories advance psychological science?

- Psychological theories are explanations that apply an integrated set of principles to organize observations and generate hypotheses—predictions that can be used to check the theory or produce practical applications of it. By testing their hypotheses, researchers can confirm, reject, or revise their theories.
- To enable other researchers to replicate the studies, researchers report them using precise operational definitions of their procedures and concepts. If others achieve similar results, confidence in the conclusion will be greater.

Multiple-Choice Questions

1. Why is an operational definition necessary when reporting research findings?
   a. An operational definition allows others to replicate the procedure.
   b. An operational definition provides more context and includes many examples of the concept described.
   c. An operational definition is easier to translate into multiple languages than a dictionary definition.
   d. An operational definition uses more scientific language than a dictionary definition.
   e. An operational definition is not necessary since a dictionary definition will work as well for replication.

2. A researcher looking for gender differences in 3-year-olds observes a preschool class and records how many minutes children of each gender play with dolls. She then compares the two sets of numbers. What type of descriptive research is she conducting?
   a. Case study
   b. National study
   c. Random sample method
   d. Naturalistic observation
   e. Survey

3. Which of the following questions is best investigated by means of a survey?
   a. Is IQ related to grades?
   b. Are violent criminals genetically different from nonviolent criminals?
   c. Does extra sleep improve memory?
   d. What is the best study technique for AP® tests?
   e. Are students more likely to be politically liberal or conservative?

4. A testable prediction that drives research is known as:
   a. Theory.
   b. Hypothesis.
   c. Operational definition.
   d. Guess.
   e. Random sample.

5. Researchers are interested in finding out if winning Congressional candidates display more positive facial expressions than losing candidates. The researchers attend political debates and record how frequently each candidate displays positive facial expressions. Which research method are the researchers using?
   a. Random sample
   b. Case study
   c. Naturalistic observation
   d. Survey
   e. Interview
6. An individual with an exceptional memory is identified. She is capable of recalling major events, the weather, and what she did on any given date. What research method is being used if a psychologist conducts an in-depth investigation of this individual including questionnaires, brain scans, and memory tests?
   a. Naturalistic observation
   b. Survey
   c. Interview
   d. Case study
   e. Correlational method

Practice FRQs

1. A teacher wants to know if nightmares are more common than dreams. He asks volunteers from his second-period class to report how many dreams they had last week. He asks volunteers from his third-period class to report the number of nightmares they had last week. Describe two things wrong with the design of this study.

Answer (2 of the following)

1 point: There is no hypothesis stated.

1 point: In asking for volunteers, the teacher is taking a nonrandom sample that is probably not representative of the population of interest.

1 point: Neither dreams nor nightmares are operationally defined, so they might be interpreted differently by later researchers.

1 point: The research is not blind. The teacher could influence the results by the way he asked questions.

7. Which of the following is most important when conducting survey research?
   a. Choosing a representative sample
   b. Choosing a large sample
   c. Choosing a biased sample
   d. Choosing a sample that includes every member of the population
   e. Choosing a sample whose answers will likely support your hypothesis

Practice FRQ 2

Award a point for any 3 of the following:

1 point: Naturalistic observation of participants may not always be practical or may result in high costs.

1 point: The data obtained may be subject to bias because researchers have to infer what has occurred because they cannot interact with the participants directly.

1 point: Researchers may make erroneous conclusions about the reasons for given behaviors.

1 point: Naturalistic observation cannot determine cause and effect relationships.
Module 6

Correlation and Experimentation

Module Learning Objectives

6-1 Describe positive and negative correlations, and explain how correlational measures can aid the process of prediction but not provide evidence of cause-effect relationships.

6-2 Explain illusory correlations.

6-3 Describe the characteristics of experimentation that make it possible to isolate cause and effect.

Correlation

What are positive and negative correlations, and why do they enable prediction but not cause-effect explanation?

Describing behavior is a first step toward predicting it. Naturalistic observations and surveys often show us that one trait or behavior is related to another. In such cases, we say the two correlate. A statistical measure (the correlation coefficient) helps us figure how closely two things vary together, and thus how well either one predicts the other. Knowing how much aptitude test scores correlate with school success tells us how well the scores predict school success.

Throughout this book we will often ask how strongly two things are related. For example, how closely related are the personality scores of identical twins? How well do intelligence test scores predict career achievement? How closely is stress related to disease? In such cases, scatterplots can be very revealing.

Each dot in a scatterplot represents the values of two variables. The three scatterplots in FIGURE 6.1 illustrate the range of possible correlations from a perfect positive to a perfect negative. (Perfect correlations rarely occur in the “real world.”) A correlation is positive if two sets of scores, such as height and weight, tend to rise or fall together.

TEACH

Using Student Activity: Correlating Test-Taking Time and Performance or Student Activity: Correlational Research from the TRM for more detailed instructions for this type of activity.

ENGAGE

TRM Active Learning

Scatterplots are easy to demonstrate to students. Collect any 2 points of data—quiz scores and hours spent studying—and have students graph them on a scatterplot. Ask students to evaluate whether the data shows any tendency toward a positive or negative correlation.

Teaching Tip

Students should know the more technical terms for positive and negative correlations:

- Positive correlations are also known as direct correlations. These variables have a direct relationship between them: As one increases or decreases, so does the other in the same direction. For example, as the number of homework assignments turned in increases, a person’s grade in math also increases.

- Negative correlations are also known as inverse correlations. These variables have an inverse relationship: As one increases, the other decreases. For example, as the number of hours watching television increases, a person’s GPA decreases.

TEACH

TRM Discussion Starter

Psychological studies are reported in the popular press on an almost daily basis. Often these studies are reported as “experiments” when they actually are correlational. Have students collect reports of studies from newspapers and magazines and evaluate whether the reports represent the appropriate interpretations of the conclusions of the studies.

- Does the report represent a correlational study as an experimental study? Why or why not?

- What are the variables that are evaluated by the study? What outcome does the article suggest can be drawn from this study?

- Are the primary researchers interviewed for the story? If so, do they caution people to interpret a correlational study appropriately? Why or why not?

Use the Module 6 Fact or Falsehood? activity from the TRM to help identify student misconceptions about this module’s content.

Columbia University: Correlational Research from the TRM for more detailed instructions for this type of activity.
Saying that a correlation is “negative” says nothing about its strength or weakness. A correlation is negative if two sets of scores relate inversely, one set going up as the other goes down. The study of Nevada university students’ inner speech discussed in Module 5 also included a correlational component. Students’ reports of inner speech correlated negatively (−.36) with their scores on another measure: psychological distress. Those who reported more inner speech tended to report slightly less psychological distress.

Statistics can help us see what the naked eye sometimes misses. To demonstrate this for yourself, try an imaginary project. Wondering if tall men are more or less easygoing, you collect two sets of scores: men’s heights and men’s temperaments. You measure the heights of 20 men, and you have someone else independently assess their temperaments (from zero for extremely calm to 100 for highly reactive). With all the relevant data right in front of you (Table 6.1), can you tell whether the correlation between height and reactive temperament is positive, negative, or close to zero?

Comparing the columns in Table 6.1, most people detect very little relationship between height and temperament. In fact, the correlation in this imaginary example is positive, +0.63, as we can see if we display the data as a scatterplot. In Figure 6.2 on the next page, moving from left to right, the upward, oval-shaped slope of the cluster of points shows that our two imaginary sets of scores (height and temperament) tend to rise together.

If we fail to see a relationship when data are presented as systematically as in Table 6.1, how much less likely are we to notice them in everyday life? To see what is right in front of us, we sometimes need statistical illumination. We can easily see evidence of gender discrimination when given statistically summarized information about job level, seniority, performance,
Common Pitfalls

Students often have trouble interpreting the correlation coefficient. They often think the negative or positive sign tells them how strong the correlation is. They believe that negative correlations indicate weak relationships. The number represents the strength of the correlation. The sign represents the direction of the correlation. A correlation coefficient of \( -0.70 \) indicates a stronger relationship than a coefficient of \( +0.65 \). The relationship for \( -0.70 \), however, is inverse rather than direct.

Emphasize to students that the term correlation does not mean causation. Remind them that a correlation tells you that certain variables are related, but not why they are related. As students learn the details about the experimental method, their ability to distinguish correlation from causation becomes very important, particularly when they need to act as critical thinkers about research reports in the media.

Use Student Activity: Correlational Research from the TRM to introduce this topic with a cafeteria experiment.

Correlation and Causation

Correlations help us predict. The New York Times reports that U.S. counties with high gun ownership rates tend to have high murder rates (Luo, 2011). Gun ownership predicts homicide. What might explain this guns-homicide correlation?

I can almost hear someone thinking, “Well, of course, guns kill people, often in moments of passion.” If so, that could be an example of A (guns) causes B (muder). But I can hear other readers saying, “Not so fast. Maybe people in dangerous places buy more guns for self-protection—maybe B causes A.” Or maybe some third variable C causes both A and B.
Correlation need not mean causation. Length of marriage correlates with hair loss in men. Does this mean that marriage causes men to lose their hair or that balding men make better husbands? In this case, as in many others, a third variable probably explains the correlation: Golden anniversaries and baldness both accompany aging.

Because many associations are stated as correlations, the famously worded principle is “Correlation does not prove causation.” That’s true, but it’s also true of associations verified by other nonexperimental statistics (Hatfield et al., 2006).

**AP® Exam Tip**

Take note of how much emphasis is put on this idea. Correlation and association do not prove a cause-and-effect relationship.

---

Because many associations are stated as correlations, the famously worded principle is “Correlation does not prove causation.” That’s true, but it’s also true of associations verified by other nonexperimental statistics (Hatfield et al., 2006).

**Figure 6.3** Three possible cause-effect relationships. People low in self-esteem are more likely to report depression than are those high in self-esteem. One possible explanation of this negative correlation is that a low self-esteem causes depressed feelings. But, as the diagram indicates, other cause-effect relationships are possible.

---

**Active Learning**

Have students go to a news website and find reports about a psychological study. Have them evaluate the article using the following questions as guidelines:

- What was the hypothesis of the study?
- Who were the participants in this study? Is this population representative of people in general?
- Is this study correlational? If so, what variables are being related? Does the article make it seem like the results are due to a cause-and-effect relationship?

**Teaching Tip**

Help students categorize the other possible conclusions resulting from correlational research:

- Directionality—Correlations simply show that a relationship exists between variables. They do not indicate in which direction the relationship works. Variable A could cause Variable B, or vice versa. For example, as violent video game playing increases, so does the tendency to engage in violent behavior. But does playing violent video games cause violent behavior? Or are people who engage in violent behavior more likely to be attracted to violent video games?
- Third Variable—Two variables can be related, but not because they cause each other. A third (or fourth, or even fifth) variable may be the cause of both of the other related variables. For example, people who ate oatmeal for breakfast as children are more likely to have cancer than people who ate Kellogg’s® Frosted Flakes instead. So, does eating oatmeal for breakfast cause cancer, or eating Frosted Flakes prevent it? Perhaps a third variable, age, could explain the relationship. Older people are more likely to have eaten oatmeal for breakfast instead of Kellogg’s® cereal, and older people are also more likely to have cancer.
**Illusory Correlations**

### 6.2 What are illusory correlations?

Correlation coefficients make visible the relationships we might otherwise miss. They also restrain our “seeing” relationships that actually do not exist. A perceived but nonexistent correlation is an *illusory correlation.* When we believe there is a relationship between two things, we are likely to notice and recall instances that confirm our belief (Troiler & Hamilton, 1986).

Because we are sensitive to dramatic or unusual events, we are especially likely to notice and remember the occurrence of two such events in sequence—say, a premonition of an unlikely phone call followed by the call. When the call does not follow the premonition, we are less likely to note and remember the nonoccurrence. Illusory correlations help explain many superstitious beliefs, such as the presumption that infertile couples who adopt become more likely to conceive (Gilovich, 1991). Couples who conceive after adopting capture our attention. We’re less likely to notice those who adopt and never conceive, or those who conceive without adopting. In other words, illusory correlations occur when we over-rely on the top left cell of **Figure 6.4**, ignoring equally essential information in the other cells.

Such illusory thinking helps explain why for so many years people believed (and many still do) that sugar makes children hyperactive, that getting chilled and wet causes people to catch a cold, and that changes in the weather trigger arthritis pain. We are, it seems, prone to perceiving patterns, whether they’re there or not.

**The point to remember:** When we notice random coincidences, we may forget that they are random and instead see them as correlated. Thus, we can easily deceive ourselves by seeing what is not there.

---

**Figure 6.4**

**Illusory correlation in everyday life**

Many people believe infertile couples become more likely to conceive a child after adopting a baby. This belief arises from their attention being drawn to such cases. The many couples who adopt without conceiving or conceive without adopting are less likely to be noticed. To determine whether there actually is a correlation between adoption and conception, we need data from all four cells in this figure. (From Gilovich, 1991)

---

### 6.3 Experimentation

**What are the characteristics of experimentation that make it possible to isolate cause and effect?**

Happy are they, remarked the Roman poet Virgil, “who have been able to perceive the causes of things.” How might psychologists perceive causes in correlational studies, such as the correlation between breast feeding and intelligence?

Researchers have found that the intelligence scores of children who were breast-fed as infants are somewhat higher than the scores of children who were bottle-fed (Angelien et al., 2001; Mortensen et al., 2002; Quinn et al., 2001). In Britain, breast-fed babies have also been more likely than their bottle-fed counterparts to eventually move into a higher social class (Martin et al., 2007). The “breast is best” intelligence effect shrinks when researchers compare breast-fed and bottle-fed children from the same families (Der et al., 2006).

---

**Concept Connections**

Daniel Kahneman won the Nobel Prize in Economics for his work with Amos Tversky on how people make irrational decisions depending on how the decision is framed. Instead of making decisions based on all available evidence, people have a tendency to make judgments based on intuition or illusory correlations. Their work has helped economists make better predictions about how markets will work. Kahneman and Tversky’s work is discussed in more detail in Unit VII. (Note: Unfortunately, Tversky died before the prize was awarded, so he did not share Kahneman’s prize. The Nobel Prize committee does not award posthumous prizes.)
Common Pitfalls

What do such findings mean? Do smarter mothers (who in modern countries more often breast feed) have smarter children? Or, as some researchers believe, do the nutrients of mother’s milk contribute to brain development? To find answers to such questions—to isolate cause and effect—researchers can experiment. Experiments enable researchers to isolate the effects of one or more variables by (1) manipulating the variables of interest and (2) holding constant (“controlling”) other variables. To do so, they often create an experimental group, in which people receive the treatment, and a contrasting control group that does not receive the treatment.

Earlier we mentioned the place of random sampling in a well-done survey. Consider the equally important place of random assignment in a well-done experiment. To minimize any preexisting differences between the two groups, researchers randomly assign people to the two conditions. Random assignment effectively equalizes the two groups. If one-third of the volunteers for an experiment can wiggle their ears, then about one-third of the people in each group will be ear wigglers. So, too, with age, attitudes, and other characteristics, which will be similar in the experimental and control groups. Thus, if the groups differ at the experiment’s end, we can surmise that the treatment had an effect.

To experiment with breast feeding, one research team randomly assigned some 17,000 Belarus newborns and their mothers either to a breast-feeding promotion program or to a normal pediatric care program (Kramer et al., 2008). At 3 months of age, 43 percent of the infants in the experimental group were being exclusively breast-fed, as were 6 percent in the control group. At age 6, when nearly 14,000 of the children were restudied, those who had been in the breast-feeding promotion group had intelligence test scores averaging six points higher than their control condition counterparts.

No single experiment is conclusive, of course. But randomly assigning participants to one feeding group or the other effectively eliminated all variables except nutrition. This supported the conclusion that breast is indeed best for developing intelligence. If a behavior (such as test performance) changes when we vary an experimental variable (such as infant nutrition), then we infer the variable is having an effect.

The point to remember: Unlike correlational studies, which uncover naturally occurring relationships, an experiment manipulates a variable to determine its effect.

Consider, then, how we might assess therapeutic interventions. Our tendency to seek new remedies when we are ill or emotionally down can produce misleading testimonies. If, three days into a cold we start taking vitamin C tablets and find our cold symptoms lessen- ing, we may credit the pills rather than the cold naturally subsiding. In the 1700s, blood-letting seemed effective. People sometimes improved after the treatment; when they didn’t, the practitioner inferred the disease was too advanced to be reversed. So, whether or not a remedy seemed effective, enthusiastic users will probably endorse it. To determine its effect, we need to experiment.

A double-blind procedure is used in an experiment in which both the research participants and the research staff are ignorant about whether the research participants have received the treatment or a placebo. Commonly used in drug evaluation studies.

There are 2 main ways to group participants in a study:

A within-subjects design involves comparing participants to themselves. Typically, the researcher will give the participants a pretest. All of the participants will be exposed to the independent variable and then will take a posttest. In this design, the participants serve as their own control group.

A between-subjects design involves comparing one group of participants to another. This is the most common experimental set up. Only one group in this design is exposed to the independent variable. The between-subjects design is more efficient because you can usually conduct the research in one sitting. However, individual differences are more likely to influence the results because the difference in groups could be due to different people being in each group. The within-subjects design is less efficient, but more resistant to the effects of individual differences, because the participants are compared to themselves.

Common Pitfalls

The need for 2 sample groups can be overlooked. Richard Sprinthall cites that a common argument against capital punishment is that it has no deterrent effect. Support for this argument can be found in the fact that, years ago, pickpockets worked the very crowds observing the public hangings of other convicted pickpockets. The fallacy is that there is no comparison group. How about the number of pockets picked in crowds at a horse race or a carnival? If pocket picking was lower at the public hangings, then perhaps capital punishment did have a deterrent effect.

In such studies, researchers can check a treatment’s actual effects apart from the participants’ and the staff’s belief in its healing powers. Just thinking you are getting a treatment can boost your spirits, relax your body, and relieve your symptoms. This placebo effect is well documented in reducing pain, depression, and anxiety (Kirsch, 2010). And the more expensive the placebo, the more “real” it seems to us—a fake pill that costs $2.50 works better than one costing 10 cents (Walter et al., 2008). To know how effective a therapy really is, researchers must control for a possible placebo effect.

**Independent and Dependent Variables**

Here is a practical experiment: In a not yet published study, Victor Benassai and his colleagues gave college psychology students frequent in-class quizzes. Some items served merely as review—students were given questions with answers. Other self-testing items required students to actively produce the answers. When tested weeks later on a final exam, students did far better on material on which they had been tested (75 percent correct) rather than merely reviewed (51 percent correct). By a wide margin, testing beat restudy.

This simple experiment manipulated just one factor: the study procedure (reading answers versus self-testing). We call this experimental factor the independent variable because we can vary it independently of other factors, such as the students’ memories, intelligence, and age. These other factors, which can potentially influence the results of the experiment, are called confounding variables. Random assignment controls for possible confounding variables. Experiments examine the effect of one or more independent variables on some measurable behavior, called the dependent variable because it can vary depending on what takes place during the experiment. Both variables are given precise operational definitions, which specify the procedures that manipulate the independent variable (the review versus self-testing study method in this analysis) or measure the dependent variable (final exam performance). These definitions answer the “What do you mean?” question with a level of precision that enables others to repeat the study. (See FIGURE 6.5 for the previously mentioned breast-milk experiment’s design.)

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

**Concept Connections**

Placebos are easiest to understand when discussing drug research, but the placebo effect can occur with any type of treatment. Studies have shown that even when people just decide to seek therapy, their problems seem to dissipate whether or not they actually complete the therapy. So researchers must take care to have all individuals in a study participate in some sort of “treatment” even if it means the control treatment is not meaningful.

Use Student Activity: The Placebo Effect from the TRM so students can experience this effect for themselves.

**Common Pitfalls**

Independent and dependent variables are very confusing for students. Provide these hints to help students keep these terms straight:

- The dependent variable (DV) is the measured variable. It is the variable that researchers expect will occur in the study. Students should look for this variable first when identifying the variables in a study. They should ask themselves, "What is the researcher measuring or looking for in this study?"

- The independent variable (IV) is the manipulated variable. It is the variable the researchers change in order to make the DV occur. Students should look for this variable second. They should ask themselves, "What do the researchers hope will cause the DV in this study?"

Use Student Activity: Main Effects and Interactions or "It All Depends" from the TRM to help students manipulate more than one independent variable in an experimental condition.

**Teaching Tip**

Help students see that controlling for confounding, extraneous variables is the goal of the experimental method. The more controlled the environment, the more likely you will be able to tell whether the IV caused the DV. A highly controlled experimental environment is not much like reality, but it does help simplify the complexity of the real world and helps provide a clearer picture of how variables in the real world work together.

**Flip It**

Have students watch the Flip It Video: Variables in Experiments for more information on this topic.
A key goal of experimental design is **validity**, which means the experiment will test what it is supposed to test. In the rental housing experiment, we might ask, “Did the e-mail inquiries test the effect of perceived ethnicity? Did the landlords’ response actually vary with the ethnicity of the name?”

Experiments can also help us evaluate social programs. Do early childhood education programs boost impoverished children’s chances for success? What are the effects of different antismoking campaigns? Do school sex-education programs reduce teen pregnancies?

To answer such questions, we can experiment. If an intervention is welcomed but resources are scarce, we could use a lottery to randomly assign some people (or regions) to experience the new program and others to a control condition. If later the two groups differ, the intervention’s effect will be supported (Passell, 1993).

Let’s recap. A **variable** is anything that can vary (infant nutrition, intelligence, TV exposure—anything within the bounds of what is feasible and ethical). Experiments aim to manipulate an independent variable, measure the dependent variable, and allow random assignment to control all other variables. An experiment has at least two different conditions: an experimental condition and a comparison or control condition. Random assignment works to equate the groups before any treatment effects occur. In this way, an experiment tests the effect of at least one independent variable (what we manipulate) on at least one dependent variable (the outcome we measure).

**TABLE 6.3** compares the features of psychology’s research methods.

---

**AP® Exam Tip**

Almost 15 pages of text are summarized in this one table. Spend some time with it, as it is information you will likely encounter on the AP® exam.

---

**Table 6.3 Comparing Research Methods**

<table>
<thead>
<tr>
<th>Research Method</th>
<th>Basic Purpose</th>
<th>How Conducted</th>
<th>What Is Manipulated</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive</td>
<td>To observe and record behavior</td>
<td>Do case studies, naturalistic observations, or surveys</td>
<td>Nothing</td>
<td>Case studies require only one participant; naturalistic observations may be done when it is not ethical to manipulate variables; surveys may be done quickly and inexpensively (compared with experiments)</td>
<td>Uncontrolled variables mean cause and effect cannot be determined; single cases may be misleading</td>
</tr>
<tr>
<td>Correlational</td>
<td>To detect naturally occurring relationships; to assess how well one variable predicts another</td>
<td>Collect data on two or more variables; no manipulation</td>
<td>Nothing</td>
<td>Works with large groups of data, and may be used in situations where an experiment would not be ethical or possible</td>
<td>Does not specify cause and effect</td>
</tr>
<tr>
<td>Experimental</td>
<td>To explore cause and effect</td>
<td>Manipulate one or more variables; use random assignment</td>
<td>The independent variable(s)</td>
<td>Specifies cause and effect, and variables are controlled</td>
<td>Sometimes not feasible, results may not generalize to other contexts; not ethical to manipulate certain variables</td>
</tr>
</tbody>
</table>

1 The independent variable, which the researchers manipulated, was the ethnicity-related names. The dependent variable, which they measured, was the positive response rate.

---

**TEACH**

**Teaching Tip**

Give students an idea of some of the different kinds of validity that researchers hope to achieve when conducting experiments.

- **Construct validity:** Do the variables represent or measure what they are supposed to measure?
- **Predictive validity:** How well do the variables measured predict other measures of the same construct?
- **Internal validity:** How well constructed was the experiment to control for confounding variables?
- **External validity:** How well do the results of the experiment translate to other settings or participants?

---

**TEACH**

**Common Pitfalls**

Be sure to emphasize the differing goals of the different research methods. Case studies and naturalistic observations only describe behavior. Correlations can be used to predict future phenomena. Experiments determine cause and effect. Students should not try to assign causal conclusions to anything but experiments.

---

**TEACH**

**Concept Connections**

Validity—as well as another important concept, reliability—of data will be discussed again in Unit XI during the discussion of testing in psychology. Students often confuse these concepts, so introducing them here might help reinforce through repetition.
ENgage

Active Learning

Conduct a simple experiment testing the hypothesis, "OREO cookies improve memory." Randomly assign students to either the experimental or control group. Give the experimental group one OREO cookie each, and do not give the control group any cookies. Then, give students a quick test of memory by having them recall a list of random words. Compare how many words each group remembers. You will find no real differences between the 2 groups. This demo provides wonderful opportunities for discussion of what went right and wrong with this experiment.

Did random assignment help control for confounding variables like IQ or gender? (Yes. Have students consider how different the results would have been if groups were divided by gender or GPA.)

Did knowing which group got the IV introduce more confounding variables? Why or why not? (Typically, participants do not know what the IV is to keep them from responding the way they think the researcher is hoping for.)

In what ways could this experiment be conducted better? (Putting each group in a different room, having a placebo, etc.)

CLOSE & ASSESS

Exit Assessment

Present students with an experimental description—either one from a previously released AP® exam free-response question or one you create on your own—and ask students to identify the independent and dependent variables, any confounding variables, and the operational definitions of those variables.

Module 6 Review

What are positive and negative correlations, and why do they enable prediction but not cause-effect explanation?

- In a positive correlation, two variables rise or fall together. In a negative correlation, one item rises as the other falls.
- Scatterplots can help us to see correlations.
- A correlation coefficient can describe the strength and direction of a relationship between two variables, from +1.00 (a perfect positive correlation) through zero (no correlation at all) to −1.00 (a perfect negative correlation).

What are illusory correlations?

- Illusory correlations are random events that we notice and falsely assume are related.
- Patterns or sequences occur naturally in sets of random data, but we tend to interpret these patterns as meaningful connections, perhaps in an attempt to make sense of the world around us.

Multiple-Choice Questions

1. Which of the following is an example of negative correlation?
   a. People who spend more time exercising tend to weigh less.
   b. Teenage females tend to have fewer speeding tickets than teenage males.
   c. Students with low IQ scores tend to have lower grades.
   d. As hours studying for a test decrease, so do grades on that test.
   e. Students’ shoe sizes are not related to their grades.

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

- To discover cause-effect relationships, psychologists conduct experiments, manipulating one or more variables of interest and controlling other variables.
- Using random assignment, they can minimize confounding variables, such as preexisting differences between the experimental group (exposed to the treatment) and the control group (given a placebo or different version of the treatment).
- The independent variable is the factor the experimenter manipulates to study its effect; the dependent variable is the factor the experimenter measures to discover any changes occurring in response to the manipulation of the independent variable.
- Studies may use a double-blind procedure to avoid the placebo effect and researcher’s bias.
- An experiment has validity if it tests what it is supposed to test.
2. Which of the following is used only in correlation studies?
   a. Double blind
   b. Placebo
   c. Random assignment
   d. Scatterplot
   e. Random sample

3. Researchers have discovered that individuals with lower income levels report having fewer hours of total sleep. Therefore,
   a. income and sleep levels are positively correlated.
   b. income and sleep levels are negatively correlated.
   c. income and sleep levels are inversely correlated.
   d. income and sleep levels are not correlated.
   e. lower income levels cause individuals to have fewer hours of sleep.

4. Which of the following correlation coefficients represents the strongest relationship between two variables?
   a. +.30
   b. +.75
   c. +1.3
   d. −.85
   e. −1.2

5. The purpose of random assignment is to
   a. allow participants in both the experimental and control groups to be exposed to the independent variable.
   b. ensure that every member of the population had an equal chance of being selected to participate in the research.
   c. eliminate the placebo effect.
   d. reduce potential confounding variables.
   e. generate operational definitions for the independent and dependent variables.

Practice FRQs

1. Students with higher scores on anxiety scales were found to have lower scores on standardized tests. What research method would show this relationship? Why can no cause-effect conclusion be drawn from the results?

Answer
1 point: This research method is a correlation study.
1 point: There are three possibilities for causation. Anxiety could cause low test scores, low test scores could cause anxiety, or a third factor could cause both anxiety and low test scores. No conclusions can be drawn about causation because this is not an experiment.

2. Ms. Ledbetter wants to determine if the new review activity she developed will improve student performance on unit exams. She randomly separates 160 students into two groups. Group A reviews for the unit exam in the traditional manner they have always used. Group B participates in the new review activity. After reviewing, both groups are given the same unit exam and their scores are compared. Identify the independent and dependent variables for this experiment.

(2 points)
Module 7

Statistical Reasoning in Everyday Life

Module Learning Objectives

7-1 Describe the three measures of central tendency, and discuss the relative usefulness of the two measures of variation.

7-2 Explain how we know whether an observed difference can be generalized to other populations.

In descriptive, correlational, and experimental research, statistics are tools that help us see and interpret what the unaided eye might miss. Sometimes the unaided eye misses badly. Researchers invited 5522 Americans to estimate the percentage of wealth possessed by the richest 20 percent in their country (Norton & Ariely, 2011). Their average person’s guess—58 percent—dramatically underestimated the actual wealth inequality. (The wealthiest 20 percent possess 84 percent of the wealth.)

The Need for Statistics

Accurate statistical understanding benefits everyone. To be an educated person today is to be able to apply simple statistical principles to everyday reasoning. One needn’t memorize complicated formulas to think more clearly and critically about data. Off-the-top-of-the-head estimates often misread reality and then mislead the public. Someone throws out a big, round number. Others echo it, and before long the big, round number becomes public misinformation. A few examples:

- Ten percent of people are lesbians or gay men. Or is it 2 to 3 percent, as suggested by various national surveys (Module 53)?
- We ordinarily use but 10 percent of our brain. Or is it closer to 100 percent (Module 12)?
- The human brain has 100 billion nerve cells. Or is it more like 40 billion, as suggested by extrapolation from sample counts (Module 18)?

The point to remember: Doubt big, round, undocumented numbers.

Statistical illiteracy also feeds needless health scares (Gigerenzer et al., 2009, 2010, 2011). In the 1990s, the British press reported a study showing

Figures can be misleading—so I’ve written a song which I think expresses the real story of the firm’s performance this quarter.”
that women taking a particular contraceptive pill had a 100 percent increased risk of blood clots that could produce strokes. This caused thousands of women to stop taking the pill, leading to a wave of unwanted pregnancies and an estimated 13,000 additional abortions (which also are associated with increased blood clot risk). And what did the study find? A 100 percent increased risk, indeed—but only from 1 in 7000 women to 2 in 7000 women. Such false alarms underscore the need to teach statistical reasoning and to present statistical information more transparently.

**Descriptive Statistics**

- **How do we describe data using three measures of central tendency, and what is the relative usefulness of the two measures of variation?**

Once researchers have gathered their data, they may use descriptive statistics to organize that data meaningfully. One way to do this is to convert the data into a simple bar graph, called a histogram, as in **FIGURE 7.1**, which displays a distribution of different brands of trucks still on the road after a decade. When reading statistical graphs such as this, take care. It’s easy to design a graph to make a difference look big (Figure 7.1a) or small (Figure 7.1b). The secret lies in how you label the vertical scale (the y-axis).

The **point to remember**: Think smart. When viewing figures in magazines and on television, read the scale labels and note their range.

**Measures of Central Tendency**

The next step is to summarize the data using some measure of central tendency, a single score that represents a whole set of scores. The simplest measure is the **mode**, the most frequently occurring score or scores. The most commonly reported is the **mean**, or arithmetic average—the total sum of all the scores divided by the number of scores. On a divided highway, the median is the middle. So, too, with data: The **median** is the midpoint—the 50th percentile. If you arrange all the scores in order from the highest to the lowest, half will be above the median and half will be below it. In a symmetrical, bell-shaped distribution of scores, the mode, mean, and median scores may be the same or very similar.

**Common Pitfalls**

- **Central tendency refers to how the data measure the center of a set of data. The mode, median, and mean all point to where the middle of the data should be.**
- **If the mode, median, and mean are all the same number, the graph of the data will look like a normal curve. If the mode, median, and mean are different, the graph will be skewed, or off center, in some way.**
- **The mean is most susceptible to extremes in the data. The mean is the number that gets pulled up or down depending on how extreme the data points are.**

**Active Learning**

- **Give students the test scores from a recent test given in your classroom (without names to protect privacy) and have them create a frequency distribution of the data. Also have them calculate the mode, median, and mean of the data. They can see how meaningful their own test scores are compared to the distribution and measures of central tendency.**

- **Use Student Activity: Teaching Statistical Concepts Using Space and Students’ Bodies from the TRM for a truly interactive practice in frequency distribution.**

**ENGAGE**

**TRM Active Learning**

- **Have students take some data and create a frequency table and chart. You can use any kind of data, from test scores to heights or shoe sizes of students in the class.**
- **To create a table, have students put each different type of data (such as the various possible heights in inches) in one column and the data points for that level of data (how many students are of that specific height) in another column.**
- **To create a chart, have students plot the number of data for each point on a graph. Students can experiment with different types of charts to see which graph presents the data in the most clear and forthright way. Typically, a bar graph is best.**

**Use Student Activity: An M&M’s Sampling Demonstration from the TRM to demonstrate data collection and analysis techniques in a fun way.**
Measures of Variation

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

The range of scores—the gap between the lowest and highest scores—provides only a crude estimate of variation. A couple of extreme scores in an otherwise uniform group, such as the $950,000 and $1,420,000 incomes in Figure 7.2, will create a deceptively large range.

The more useful standard for measuring how much scores deviate from one another is the standard deviation. It better gauges whether scores are packed together or dispersed, because it uses information from each score (TABLE 7.1). The computation assembles information about how much individual scores differ from the mean. If your high school serves a community where most families have similar incomes, family income data will have a relatively small standard deviation compared with the more diverse community population outside your school.

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

As FIGURE 7.3 shows, a useful property of the normal curve is that roughly 68 percent of the cases fall within one standard deviation on either side of the mean. About 95 percent of cases fall within two standard deviations. Thus, as Module 61 notes, about 68 percent of people taking an intelligence test will score within ±15 points of 100. About 95 percent will score within ±30 points.

Table 7.1 Standard Deviation Is Much More Informative Than Mean Alone

<table>
<thead>
<tr>
<th>Score</th>
<th>Deviation from the Mean</th>
<th>Squared Deviation</th>
<th>Score</th>
<th>Deviation from the Mean</th>
<th>Squared Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>−8</td>
<td>64</td>
<td>60</td>
<td>−20</td>
<td>400</td>
</tr>
<tr>
<td>74</td>
<td>−6</td>
<td>36</td>
<td>60</td>
<td>−20</td>
<td>400</td>
</tr>
<tr>
<td>77</td>
<td>−3</td>
<td>9</td>
<td>70</td>
<td>−10</td>
<td>100</td>
</tr>
<tr>
<td>79</td>
<td>−1</td>
<td>1</td>
<td>70</td>
<td>−10</td>
<td>100</td>
</tr>
<tr>
<td>82</td>
<td>+2</td>
<td>4</td>
<td>90</td>
<td>+10</td>
<td>100</td>
</tr>
<tr>
<td>84</td>
<td>+4</td>
<td>16</td>
<td>90</td>
<td>+10</td>
<td>100</td>
</tr>
<tr>
<td>85</td>
<td>+5</td>
<td>25</td>
<td>100</td>
<td>+20</td>
<td>400</td>
</tr>
<tr>
<td>87</td>
<td>+7</td>
<td>49</td>
<td>100</td>
<td>+20</td>
<td>400</td>
</tr>
</tbody>
</table>

Total = 640  Sum of (deviations)² = 204
Mean = 640 ÷ 8 = 80
Standard deviation = √(Sum of (deviations)² / Number of scores) = √(204 / 8) = 5.0

Total = 640  Sum of (deviations)² = 2000
Mean = 640 ÷ 8 = 80
Standard deviation = √(Sum of (deviations)² / Number of scores) = √(2000 / 8) = 15.8

Figure 7.3 The normal curve. Scores on aptitude tests tend to form a normal, or bell-shaped, curve. For example, the most commonly used intelligence test, the Wechsler Adult Intelligence Scale, calls the average score 100.

As FIGURE 7.3 shows, a useful property of the normal curve is that roughly 68 percent of the cases fall within one standard deviation on either side of the mean. About 95 percent of cases fall within two standard deviations. Thus, as Module 61 notes, about 68 percent of people taking an intelligence test will score within ±15 points of 100. About 95 percent will score within ±30 points.

TEACH
Teaching Tip
Standard deviation tells us how different the scores are from each other. Notice how Myers points out that less variability is better than greater variability. Therefore, if a group of scores has a smaller standard deviation, then you can draw more stable conclusions from that data set. If the set of scores has a large standard deviation, the conclusions you can draw are less stable.

TEACH
Teaching Tip
Knowing the percentages of scores that fall 1, 2, and 3 standard deviations from the mean is important for the AP® exam (see Figure 7.3). Make sure students know these percentages well.

TEACH
Flip It
Have students watch Flip It Video: The Normal Curve for more information on this bell-shaped distribution.
Inferential Statistics

7-2 How do we know whether an observed difference can be generalized to other populations?

Data are “noisy.” The average score in one group (breast-fed babies) could conceivably differ from the average score in another group (bottle-fed babies) not because of any real difference but merely because of chance fluctuations in the people sampled. How confidently, then, can we infer that an observed difference is not just a fluke—a chance result of your sampling? For guidance, we can ask how reliable and significant the differences are. These inferential statistics help us determine if results can be generalized to a larger population.

When Is a Difference Significant?

In deciding when it is safe to generalize from a sample, we should keep three principles in mind.

1. Representative samples are better than biased samples. As noted in Module 5, the best basis for generalizing is not from the exceptional and memorable cases one finds at the extremes but from a representative sample of cases. Research never randomly samples the whole human population. Thus, it pays to keep in mind what population a study has sampled.

2. Less-variable observations are more reliable than those that are more variable. As we noted in the example of the basketball player whose game-to-game points were consistent, an average is more reliable when it comes from scores with low variability.

3. More cases are better than fewer. An eager high school senior visits two university campuses, each for a day. At the first, the student randomly attends two classes and discovers both instructors to be witty and engaging. At the next campus, the two sampled instructors seem dull and uninspiring. Returning home, the student discovers both instructors to be witty and engaging. At the first school, and the friends about the “great instructors” at the first school, and the “bores” at the second.

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

When Is a Difference Significant?

Perhaps you’ve compared men’s and women’s scores on a laboratory test of aggression, and found a gender difference. But individuals differ. How likely is it that the gender difference you found was just a fluke? Statistical testing can estimate the probability of the result occurring by chance.

Here is the underlying logic: When averages from two samples are each reliable measures of their respective populations (as when each is based on many observations that have small variability), then their difference is likely to be reliable as well. (Example: The less the variability in women’s and in men’s aggression scores, the more confidence we would have that any observed gender difference is reliable.) And when the difference between the sample averages is large, we have even more confidence that the difference between them reflects a real difference in their populations.

In short, when sample averages are reliable, and when the difference between them is relatively large, we say the difference has statistical significance. This means that the observed difference is probably not due to chance variation between the samples.

In judging statistical significance, psychologists are conservative. They are like juries who must presume innocence until guilt is proven. For most psychologists, proof beyond a
reasonable doubt means not making much of a finding unless the odds of its occurring by chance, if no real effect exists, are less than 5 percent.

When reading about research, you should remember that, given large enough samples, a difference between them may be "statistically significant" yet have little practical significance. For example, comparisons of intelligence test scores among hundreds of thousands of first-born and later-born individuals indicate a highly significant tendency for first-born individuals to have higher average scores than their later-born siblings (Kristensen & Bjerkedal, 2007; Zajonc & Markus, 1975). But because the scores differ by only one to three points, the difference has little practical importance.

The point to remember: Statistical significance indicates the likelihood that a result will happen by chance. But this does not say anything about the importance of the result.

**AP® Exam Tip**
Sometimes a phrase that is frequently used in the media has a more specific meaning when used in psychology. That's the case with the phrase "statistically significant." Make sure you know the precise meaning.

**Before You Move On**

**ASK YOURSELF**
Find a graph in a popular magazine ad. How does the advertiser use (or abuse) statistics to make a point?

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

Answers to the "Test Yourself" questions can be found in Appendix E at the end of the book.

**Module 7 Review**

7-1 How do we describe data using three measures of central tendency, and what is the relative usefulness of the two measures of variation?

- A measure of central tendency is a single score that represents a whole set of scores. Three such measures are the mode (the most frequently occurring score), the mean (the arithmetic average), and the median (the middle score in a group of data).
- Measures of variation tell us how diverse data are. Two measures of variation are the range (which describes the gap between the highest and lowest scores) and the standard deviation (which states how much scores vary around the mean, or average, score).
- Scores often form a normal (or bell-shaped) curve.

**Module 7 Review**

7-1 How do we describe data using three measures of central tendency, and what is the relative usefulness of the two measures of variation?

- A measure of central tendency is a single score that represents a whole set of scores. Three such measures are the mode (the most frequently occurring score), the mean (the arithmetic average), and the median (the middle score in a group of data).
- Measures of variation tell us how diverse data are. Two measures of variation are the range (which describes the gap between the highest and lowest scores) and the standard deviation (which states how much scores vary around the mean, or average, score).
- Scores often form a normal (or bell-shaped) curve.
Answers to Multiple-Choice Questions

1. a  
2. a  
3. b  
4. e  
5. d

Multiple-Choice Questions

1. Which of the following is a measure of variation?
   a. Range
   b. Mean
   c. Mode
   d. Frequency
   e. Median

2. Which statistical measure of central tendency is most affected by extreme scores?
   a. Mean
   b. Median
   c. Mode
   d. Skew
   e. Correlation

3. A researcher calculates statistical significance for her study and finds a 5 percent chance that results are due to chance. Which of the following is an accurate interpretation of this finding?
   a. This is well beyond the range of statistical significance.
   b. This is the minimum result typically considered statistically significant.
   c. This is statistically significant.
   d. There is no way to determine statistical significance without replication of the study.
   e. Chance or coincidence is unrelated to statistical significance.

4. Descriptive statistics ______ while inferential statistics ______.
   a. indicate the significance of the data; summarize the data
   b. describe data from experiments; describe data from surveys and case studies
   c. are measures of central tendency; are measures of variance
   d. determine if data can be generalized to other populations; summarize data
   e. summarize data; determine if data can be generalized to other populations

5. In a normal distribution, what percentage of the scores in the distribution falls within one standard deviation on either side of the mean?
   a. 34 percent
   b. 40 percent
   c. 50 percent
   d. 68 percent
   e. 95 percent

How do we know whether an observed difference can be generalized to other populations?

To feel confident about generalizing an observed difference to other populations, we would want to know that:

• the sample studied was representative of the larger population being studied;
• the observations, on average, had low variability;
• the sample consisted of more than a few cases; and
• the observed difference was statistically significant.
1. Explain the difference between descriptive and inferential statistics in research.

**Answer (2 points)**

1 point: Descriptive statistics organize and summarize the data collected during research.

1 point: Inferential statistics are used to help determine whether results can be generalized to a larger population through the calculation of statistical significance.

---

2. The following data set includes information from survey research in a psychology course regarding how many hours each individual in the class spent preparing for the exam. Examine the data and respond to the following:

- What is the middle score in this distribution? What term is used to describe the middle score?
- What would be the most useful statistic for measuring the variation of the hours spent studying? Why is this statistic a better measure of variation than the range?

**Answer to Practice FRQ 2**

1 point: The middle score is 8, and it is called the median.

1 point: The most useful statistic for measuring variation is the standard deviation.

1 point: The standard deviation is a better measure of variation than the range because it considers all scores rather than just the 2 most extreme scores.
Module 8

Frequently Asked Questions About Psychology

Module Learning Objectives

8-1 Explain the value of simplified laboratory conditions in illuminating everyday life.
8-2 Discuss whether psychological research can be generalized across cultures and genders.
8-3 Explain why psychologists study animals, and describe the ethical guidelines that safeguard animal research participants.
8-4 Describe the ethical guidelines that safeguard human research participants.
8-5 Examine whether psychology is free of value judgments.

Common Pitfalls

One of the goals of research is to be able to generalize the findings to the public at large. A study has little value if the findings only apply to a specific group of people. The more a study is replicated, the more likely the findings can be applied to the general public. This generalizability of studies helps eventually make the findings applicable to the real world.

Module 8 Fact or Falsehood? activity from the TRM to help identify student misconceptions about this module’s content.

Psychology Applied

Can laboratory experiments illuminate everyday life?

When you see or hear about psychological research, do you ever wonder whether people’s behavior in the lab will predict their behavior in real life? For example, does detecting the blink of a faint red light in a dark room have anything useful to say about flying a plane at night? If, after playing violent video games in the lab, teens become more willing to push buttons that they think electrically shock someone, does this indicate that playing shooter games makes someone more likely to commit violence in everyday life?
Before you answer, consider: The experimenter intends the laboratory environment to be a simplified reality—one that simulates and controls important features of everyday life. Just as a wind tunnel lets airplane designers re-create airflow forces under controlled conditions, a laboratory experiment lets psychologists re-create psychological forces under controlled conditions.

An experiment’s purpose is not to re-create the exact behaviors of everyday life but to test theoretical principles (Mook, 1983). In aggression studies, deciding whether to push a button that delivers a shock may not be the same as slapping someone in the face, but the principle is the same. It is the resulting principles—not the specific findings—that help explain everyday behaviors.

When psychologists apply laboratory research on aggression to actual violence, they are applying theoretical principles of aggressive behavior, principles they have refined through many experiments. Similarly, it is the principles of the visual system, developed from experiments in artificial settings (such as looking at red lights in the dark), that researchers apply to more complex behaviors such as night flying. And many investigations show that principles derived in the laboratory do typically generalize to the everyday world (Anderson et al., 1999).

The point to remember: Psychological science focuses less on particular behaviors than on seeking general principles that help explain many behaviors. And remember: Although psychological principles may help predict behaviors for groups of people, they minimally predict behavior for any individual. Knowing students’ grade level may clue us to their average vocabulary level, but individual students’ word power will vary.

## 8.2 Does behavior depend on one’s culture and gender?

What can psychological studies done in one time and place—often with people from what researchers call the WEIRD (Western, Educated, Industrialized, Rich, and Democratic) cultures (Henrich et al., 2010) really tell us about people in general? As we will see time and again, culture—shared ideas and behaviors that one generation passes on to the next—matters. Our culture shapes our behavior. It influences our standards of promptness and frankness, our attitudes toward premarital sex and varying body shapes, our tendency to be casual or formal, our willingness to make eye contact, our conversational distance, and much, much more. Collectivist cultures, for example, emphasize group goals, while individualist cultures put a priority on individual goals. Being aware of such differences, we can restrain our assumptions that others will think and act as we do. Given the growing mixing and clashing of cultures, our need for such awareness is urgent.

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

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

### Diversity Connections

Present students with some examples of normal behavior from other cultures. This can help students appreciate the importance of conducting research with people from diverse backgrounds:

- Public displays of affection between men and women in Thailand are unacceptable. Interestingly, however, men holding hands is considered a sign of friendship.
- In the village of Ban Chan in Thailand, face-to-face conflict must be avoided at all costs, even to the point of not reporting something unpleasant. For example, one would not say, “Your house is burning.” Better to ask, “Why don’t you go see your house?” The polite way to say no is to giggle.
- In many societies where hunger is endemic, fat women are viewed as much more attractive than slender ones.
- By leaving some food on the plate, a guest in India indicates the generosity of the host who has put so much food out that no one could eat it all. In fact, well-meaning visitors can find themselves offending their hosts by following their own custom of eating all the food served to them.
- In Latino/a cultures, children, especially girls, are socialized to value conformity to social norms. Rebelliousness and delinquency are rare. Mexican adolescents are reluctant to engage in any activity that might bring shame to their families.

### Teaching Tip

Have students discuss what other behaviors might be common to all people and what might be particular to a culture or gender. Emphasize to students that if a study is designed well, it can be conducted with multiple samples that will eventually represent people from all cultural and gender perspectives.

### Concept Connections

In the past, psychological studies have often been criticized for using samples that are not representative of the general public: for example, by not including multiple cultures or both genders. One famous researcher whose studies are often criticized for this is Lawrence Kohlberg. Kohlberg conducted several studies on moral development, but he only used White teenage boys from Chicago. Some critics, like psychologist Carol Gilligan, believe his findings cannot be applied to girls or to people from non-White cultural backgrounds because of this limitation. Have students consider assumptions they make about “normal” behavior at their school. Would their school behavior be considered normal at a neighboring school? At college?
ENGAGE

TRM  Active Learning

The APA Ethics Code requires institutions that allow animal experimentation to establish an Animal Care and Use Committee to review whether the studies done on animals follow ethical standards. Divide students into groups and, using Student Activity: Animal Care and Use Committee (from the TRM), have them test their knowledge of the ethics of animal research by pretending to be on an Animal Care and Use Committee to determine whether a series of experiments should be allowed to go forward.

TEACH

Teaching Tip

Have students discuss any other ethical considerations that might be necessary for conducting experiments on human and nonhuman subjects. Challenge them to develop an ethics code for conducting their own experiments.

- What considerations might need to be enhanced?
- What additional ethical considerations must be followed when working with minors?
- How does the use of deception affect the ethics of a study?

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

You will see throughout this book that gender matters, too. Researchers report gender differences in what we dream, in how we express and detect emotions, and in our risk for alcohol use disorder, depression, and eating disorders. Gender differences fascinate us, and studying them is potentially beneficial. For example, many researchers believe that women carry on conversations more readily to build relationships, while men talk more to give information and advice (Tannen, 2001). Knowing this difference can help us prevent conflicts and misunderstandings in everyday relationships.

But again, psychologically as well as biologically, women and men are overwhelmingly similar. Whether female or male, we learn to walk at about the same age. We experience the same sensations of light and sound. We feel the same pangs of hunger, desire, and fear. We exhibit similar overall intelligence and well-being.

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

Ethics in Research

8-3 Why do psychologists study animals, and is it ethical to experiment on animals?

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

Humans are complex. But the same processes by which we learn are present in rats, monkeys, and even sea slugs. The simplicity of the sea slug’s nervous system is precisely what makes it so revealing of the neural mechanisms of learning. Sharing such similarities, should we not respect our animal relatives? "We cannot defend our scientific work with animals on the basis of the similarities between them and ourselves and then defend it morally on the basis of differences," noted Roger Ulrich (1992). The animal protection movement protests the use of animals in psychological, biological, and medical research. Researchers remind us that the animals used worldwide each year in research are but a fraction of 1 percent of the billions of animals killed annually for food. And yearly, for every dog or cat used in an experiment and cared for under humane regulations, 50 others are killed in humane animal shelters (Goodwin & Morrison, 1999).

Some animal protection organizations want to replace experiments on animals with naturalistic observation. Many animal researchers respond that this is not a question of good versus evil but of compassion for animals versus compassion for people. How many of us would have attacked Louis Pasteur’s experiments with rabbits, which caused some dogs to suffer but led to a vaccine that spared millions of people (and dogs) from agonizing death? And would we really wish to have deprived ourselves of the animal research that led to effective methods of treating children with mental disorders, of understanding aging, and of relieving fears and depression? The answers to such questions vary by culture. In Gallup surveys in Canada and the United States, about 60 percent of adults deem medical testing on animals “morally acceptable.” In Britain, only 37 percent do (Mason, 2003).

Out of this heated debate, two issues emerge. The basic one is whether it is right to place the well-being of humans above that of animals. In experiments on stress and cancer, is it right that mice get tumors in the hope that people might not? Should some monkeys be
exposed to an HIV-like virus in the search for an AIDS vaccine? Is our use and consumption of other animals as natural as the behavior of carnivorous hawks, cats, and whales? Defenders of research on animals argue that anyone who has eaten a hamburger, worn leather shoes, tolerated hunting and fishing, or supported the extermination of crop-destroying or plague-carrying pests has already agreed that, yes, it is sometimes permissible to sacrifice animals for the sake of human well-being.

Scott Plous (1993) notes, however, that our compassion for animals varies, as does our compassion for people—based on their perceived similarity to us. As Module 79 explains, we feel more attraction, give more help, and act less aggressively toward similar others. Likewise, we value animals according to their perceived kinship with us. Thus, primates and companion pets get top priority. (Western people raise or trap mink and foxes for their fur, but not dogs or cats.) Other mammals occupy the second rung on the privilege ladder, followed by birds, fish, and reptiles on the third rung, with insects at the bottom. In deciding which animals have rights, we each draw our own cut-off line somewhere across the animal kingdom.

If we give human life first priority, what safeguards should protect the well-being of animals in research? One survey of animal researchers gave an answer. Some 98 percent supported government regulations protecting primates, dogs, and cats, and 74 percent supported regulations providing for the humane care of rats and mice (Plous & Herzog, 2000). Many professional associations and funding agencies already have such guidelines. British Psychological Society guidelines call for housing animals under reasonably natural living conditions, with companions for social animals (Lea, 2008). American Psychological Association (APA) guidelines state that researchers must ensure the “comfort, health, and humane treatment” of animals and minimize “infection, illness, and pain” (APA, 2002). The European Parliament now mandates standards for animal care and housing (Vogel, 2010).

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

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

Animal research benefiting animals. These gorillas are enjoying an improved quality of life in New York’s Bronx Zoo.
Concept Connections
Discuss with students the additional ethical considerations of confidentiality and anonymity.

- Confidentiality refers to keeping participant information private. If a researcher collects identifying information, that information must not be released and the data must not be presented so that the individual participants can be identified through any kind of process of elimination.

- Anonymity refers to participating in a study without providing identifying information. Many studies do not require participants to identify themselves at all. For some research, the guarantee of anonymity might help participants respond more truthfully.

Common Pitfalls
Make sure students understand that informed consent is a process. Participants must be continually informed throughout the experimental process about their rights and protections so they can decide whether they want to continue to participate.

What ethical guidelines safeguard human participants?

Does the image of white-coated scientists delivering electric shocks trouble you? If so, you’ll be relieved to know that most psychological studies are free of such stress. With people, blinking lights, flashing words, and pleasant social interactions are more common. Moreover, psychology’s experiments are mild compared with the stress and humiliation often inflicted by reality TV shows. In one episode of The Bachelor, a man dumped his new fiancée—on camera, at the producers’ request—for the woman who earlier had finished second (Collins, 2009).

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

Ethical principles developed by the American Psychological Association (2010), by the British Psychological Society (2019), and by psychologists internationally (Pettifor, 2004), urge researchers to (1) obtain potential participants’ informed consent, (2) protect them from physical or emotional harm and discomfort, (3) keep information about individual participants confidential, and (4) fully debrief people (explain the research afterward). Moreover, most universities (where a great deal of research is conducted) now have an ethics committee—an Institutional Review Board (IRB)—that screens research proposals and safeguards participants’ well-being.

The ideal is for a researcher to be sufficiently informative and considerate so that participants will feel at least as good about themselves as when they came in. Better yet, they should be repaid by having learned something.

Is psychology free of value judgments?

Psychology is definitely not value-free. Values affect what we study, how we study it, and how we interpret results. Researchers’ values influence their choice of topics. Should we study worker productivity or worker morale? Sex discrimination or gender differences? Conformity or independence? Values can also color “the facts.” As we noted earlier, our preconceptions can bias our observations and interpretations; sometimes we see what we want or expect to see (FIGURE 8.1).

Even the words we use to describe something can reflect our values. In psychology and in everyday speech, labels describe and labels evaluate: One person’s rigid is another’s omnisexuality. One person’s faith is another’s fanaticism. One country’s enhanced interrogation techniques, such as cold-water immersion, become torture when practiced by its enemies. Our labeling someone as firm or stubborn, careful or picky, discreet or secretive reveals our own attitudes.

Concrete Concept
Informed consent an ethical principle that research participants be told enough to enable them to choose whether they wish to participate.

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

"It is doubtless impossible to approach any human problem with a mind free from bias."—Sims in Bulletin, The Second Sex, 1952

8-5 What do you see? Our expectations influence what we perceive. Did you see a duck or a rabbit? Show some friends this image with the rabbit photo above covered up and tell them they are more likely to perceive a duck head instead. (From Shepard, 1965)

8-6 Teaching Tip
Some people think science should be value-free. Those people might believe that psychology is not a science because it often reflects or examines “soft” topics such as values. The methodology of psychology defines it as a science, and using the scientific method to examine soft topics enhances our understanding of these types of topics. The method is value-free, but the conclusions are not.
Popular applications of psychology also contain hidden values. If you defer to “professional” guidance about how to live—how to raise children, how to achieve self-fulfillment, what to do with sexual feelings, how to get ahead at work—you are accepting value-laden advice. A science of behavior and mental processes can help us reach our goals. But it cannot decide what those goals should be.

If some people see psychology as merely common sense, others have a different concern—that it is becoming dangerously powerful. Is it an accident that astronomy is the oldest science and psychology the youngest? To some, exploring the external universe seems far safer than exploring our own inner universe. Might psychology, they ask, be used to manipulate people?

Knowledge, like all power, can be used for good or evil. Nuclear power has been used to light up cities—and to demolish them. Persuasive power has been used to educate people—and to deceive them. Although psychology does indeed have the power to deceive, its purpose is to enlighten. Every day, psychologists are exploring ways to enhance learning, creativity, and compassion. Psychology speaks to many of our world’s great problems—war, overpopulation, prejudice, family crises, crime—all of which involve attitudes and behaviors. Psychology also speaks to our deepest longings—for nourishment, for love, for happiness. Psychology cannot address all of life’s great questions, but it speaks to some mighty important ones.

**ASK YOURSELF**
Were any of this module’s Frequently Asked Questions your questions? Do you have other questions or concerns about psychology?

**TEST YOURSELF**
How are human and animal research participants protected?
Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

**Module 8 Review**

**B-1** Can laboratory experiments illuminate everyday life?

- Researchers intentionally create a controlled, artificial environment in the laboratory in order to test general theoretical principles. These general principles help explain everyday behaviors.

**B-2** Does behavior depend on one’s culture and gender?

- Attitudes and behaviors may vary somewhat by gender or across cultures, but because of our shared human kinship, the underlying processes and principles are more similar than different.

**B-3** Why do psychologists study animals, and is it ethical to experiment on animals?

- Some psychologists are primarily interested in animal behavior; others want to better understand the physiological and psychological processes shared by humans and other species.
- Government agencies have established standards for animal care and housing. Professional associations and funding agencies also establish guidelines for protecting animals’ well-being.
Answers to Multiple-Choice Questions

1. c  3. d
2. b  4. b

Answer to Practice FRQ 2

1 point: Informed consent is the principle that governs what students must be told before the research takes place.

1 point: The students should be told that the research involves potentially stressful events or extensive medical testing.

1 point: Confidentiality is the principle that governs appropriate use of the medical results.

1 point: An individual’s research results cannot be released or discussed without that participant’s permission.
## Unit II Review

### Key Terms and Concepts to Remember

- hindsight bias, p. 31
- critical thinking, p. 35
- theory, p. 38
- hypothesis, p. 38
- operational definition, p. 39
- replication, p. 39
- case study, p. 40
- naturalistic observation, p. 40
- survey, p. 42
- sampling bias, p. 43
- population, p. 43
- random sample, p. 43
- correlation, p. 46
- correlation coefficient, p. 46
- scatterplot, p. 46
- illusory correlation, p. 50
- experiment, p. 51
- experimental group, p. 51
- control group, p. 51
- random assignment, p. 51
- double-blind procedure, p. 51
- placebo [pluh-SEE-bo] effect, p. 52
- independent variable, p. 52
- confounding variable, p. 52
- dependent variable, p. 52
- validity, p. 53
- descriptive statistics, p. 57
- mode, p. 57
- mean, p. 57
- median, p. 57
- skewed distribution, p. 58
- range, p. 58
- standard deviation, p. 58
- normal curve, p. 59
- inferential statistics, p. 60
- statistical significance, p. 60
- culture, p. 65
- informed consent, p. 68
- debriefing, p. 68

### AP® Exam Practice Questions

#### Multiple-Choice Questions

1. Which descriptive statistic would a researcher use to describe how close a student’s SAT score is to a school’s average SAT score?
   - a. Correlation coefficient
   - b. Mean
   - c. Median
   - d. Standard deviation
   - e. Range

2. Which method should a psychology researcher use if she is interested in testing whether a specific reward in a classroom situation causes students to behave better?
   - a. Case study
   - b. Experiment
   - c. Survey
   - d. Naturalistic observation
   - e. Correlation

3. When a distribution of scores is skewed, which of the following is the most representative measure of central tendency?
   - a. Inference
   - b. Standard deviation
   - c. Mean
   - d. Median
   - e. Correlation coefficient

4. A researcher wants to conduct an experiment to determine if eating a cookie before class each day improves student grades. He uses two psychology classes for the experiment, providing daily cookies to one and nothing to the other. At the end of the semester, the researcher compares the final grades of students in the two classes. What is the independent variable for this experiment?
   - a. The students in the class that received cookies
   - b. The presence or absence of cookies
   - c. The students in the class that didn’t receive cookies
   - d. The period of the day that the two classes met
   - e. Semester grades

### Answers to Multiple-Choice Questions

1. d
2. b
3. d
4. b
5. Which of the following represents naturalistic observation?
   a. Researchers watch and record how elementary school children interact on the playground.
   b. Researchers bring participants into a laboratory to see how they respond to a puzzle with no solution.
   c. A principal looks at the relationship between the number of student absences and their grades.
   d. A social worker visits a family home and gives feedback on family interactions.
   e. Two grandparents sit in the front row to watch their grandson’s first piano recital.

6. “Monday morning quarterbacks” rarely act surprised about the outcome of weekend football games. This tendency to believe they knew how the game would turn out is best explained by which psychological principle?
   a. Overconfidence
   b. Hindsight bias
   c. Intuition
   d. Illusory correlation
   e. Random sampling

7. Researchers studying gender have found that
   a. there are more similarities than differences between the genders.
   b. there are no significant cognitive differences between the genders.
   c. there are no significant emotional differences between the genders.
   d. research tools are not capable of determining if there are true differences or not.
   e. differences between the genders are becoming more pronounced over time.

8. A journalism student is writing an article about her school’s new cell-phone policy, and she’d like to interview a random sample of students. Which of the following is the best example of a random sample?
   a. The writer arrives at school early and interviews the first five students who come through the main entrance.
   b. The writer pulls the names of five students from a hat that contains all students’ names. She interviews the five selected students.
   c. The writer asks her teacher if she can distribute a brief survey to the students in her AP® Psychology class.
   d. The writer passes out brief surveys to 50 students in the hall and uses the 38 surveys returned to her as the basis of her article.
   e. The writer asks the principal for the names of 10 students who have had their cell phones confiscated for a day for violating the policy. She interviews these 10 students.

9. Which of the following is a positive correlation?
   a. As study time decreases, students achieve lower grades.
   b. As levels of self-esteem decline, levels of depression increase.
   c. People who exercise regularly are less likely to be obese.
   d. Gas mileage decreases as vehicle weight increases.
   e. Repeatedly shooting free throws in basketball is associated with a smaller percentage of missed free throws.

10. Why is random assignment of participants to groups an important aspect of a properly designed experiment?
    a. If the participants are randomly assigned, the researcher can assume that the people in each of the groups are pretty similar.
    b. By randomly assigning participants, the researcher knows that whatever is learned from the experiment will also be true for the population from which the participants were selected.
    c. Random assignment keeps expectations from influencing the results of the experiment.
    d. If participants are not randomly assigned, it is impossible to replicate the experiment.
    e. Statistical analysis cannot be performed on an experiment if random assignment is not used.

11. Which of the following demonstrates the need for psychological science?
    a. Psychology’s methods are unlike those of any other science.
    b. Psychological experiments are less valuable without psychological science.
    c. Our intuitions about human thinking and behavior are not always accurate.
    d. Intuition does not provide correct answers unless it is applied through the scientific method.
    e. Psychological science research is superior to that of other sciences like biology and physics.

12. Which of the following is a potential problem with case studies?
    a. They provide too much detail and the researcher is likely to lose track of the most important facts.
    b. They are generally too expensive to be economical.
    c. They may be misleading because they don’t fairly represent other cases.
    d. They are technically difficult and most researchers don’t have the skills to do them properly.
    e. The dependent variable is difficult to operationally define in a case study.
13. Which of the following is not an ethical principle regarding research on humans?
   a. Researchers must protect participants from needless harm and discomfort.
   b. Participants must take part in the study on a voluntary basis.
   c. Personal information about individual participants must be kept confidential.
   d. Research studies must be fully explained to participants when the study is completed.
   e. Participants should always be informed of the hypothesis of the study before they agree to participate.

14. There is a negative correlation between TV watching and grades. What can we conclude from this research finding?
   a. We can conclude that a student who watches a lot of TV is likely to have lower grades.
   b. We can conclude that TV watching leads to lower grades.
   c. We can conclude that TV watching leads to higher grades.
   d. We can conclude that the grades students get don't impact their TV watching habits.
   e. We can conclude that this is an illusory correlation.

Free-Response Questions

1. Sam Greene noticed an ad for an Internet dating service that claimed more people who used its service are in long-term relationships than people who didn't. Sam, a good critical thinker, knows this isn't enough to claim that the service causes people to find long-term love and wants to create an experiment to investigate. Use the following terms to describe an experiment that would support or dispute the ad's claim.
   a. Hypothesis
   b. Random sample
   c. Random assignment
   d. Operational definition
   e. Independent variable
   f. Dependent variable
   g. Inferential statistics

Rubric for Free-Response Question 1

1 point: The hypothesis in this context is that the Internet dating service causes (or leads to) long-term relationships.

1 point: Since the population of interest for this study should be people who are looking for long-term relationships, selecting a random sample of adults seeking relationships would help assure that the conclusions could be fairly generalized to the dating public.

1 point: In this case, participants should be randomly assigned to use of the Internet service (the experimental group) or not (the control group).

1 point: A positive or direct correlation is a statistical finding that indicates a relationship between variables in which they both move in the same direction whether they are increasing or decreasing.

1 point: Dr. Tabor discovered through her research that for her participants a positive correlation (+.89) existed between the amount of sleep students received and their levels of alertness in class. This means that the more sleep students received, the more alert they were in class, and the less sleep students received, the less alert they were in class.

Rubric for Free-Response Question 2

1 point: A random sample is a subset of the population that is chosen in a manner that allows each individual in the overall population to have an equal chance of being selected to participate in the research.

1 point: Dr. Tabor is not using a random sample because she is only choosing participants from her own courses, which means that every member of the population (American university students) did not have an equal chance of being chosen to participate.

1 point: A scatterplot is a graphed depiction of the relationship between 3 variables. Each dot on the graph represents the values of 2 variables for one participant. The slope of the dots indicates the relationship (positive or negative) between the variables, and the amount of scatter indicates the strength of the relationship between the 2 variables.

1 point: After Dr. Tabor places her data on a scatterplot, she realizes by the upward slope of her graphed data points that the relationship between sleep and alertness is positive or direct. As a result of low amounts of scatter in her graphed data, Dr. Tabor can conclude that the strength of the relationship is high, which predicts a correlation coefficient close to +1.00, which in this case was +.89.

1 point: The effects of wording are a potential problem in survey research because the manner in which a question is phrased can result in differences in how participants respond to questions and can affect results.

1 point: Dr. Tabor’s results may be affected by the manner in which she poses questions to the participants. For example, she may receive different results if she asks students “if they feel more alert” as opposed to “when did they notice they were more alert.”
Rubric for Free-Response Question 3

Point 1: **Lack of informed consent**
There is no indication Dr. Pauling provided the participants with enough information for them to consent to be involved in the study, which is a violation of ethical principles of research with human participants. *(p. 68)*

Point 2: **Protect from harm and discomfort**
Based on the release form, participants might have experienced physical harm as a result of their participation in the study, which is a violation of ethical principles of research with human participants. *(p. 68)*

Point 3: **No random assignment to groups**
Choosing groups by seating arrangements (the left or right side of the room) is not random, which might cause confounding variables to interfere with Dr. Pauling’s results and conclusions. *(p. 51)*

Point 4: **No debriefing**
Ethical principles of research with human participants require researchers to inform participants of the nature of the research after it is completed, and Dr. Pauling did not do this. *(p. 68)*

Point 5: **Lack of confidentiality**
Dr. Pauling published results and student names in the college newspaper which violates confidentiality, a violation of ethical principles of research with human participants. *(p. 68)*

---

2. Dr. Tabor wanted to investigate the relationship between sleep and levels of alertness during a class for American university students. She gave surveys to 150 college freshmen in her introduction to psychology course, asking them to report how many hours they slept each night during a two-week period. Dr. Tabor also had the participants rate their level of alertness on a scale of 1 to 10, with 10 being the most alert each day at the end of class. Dr. Tabor compared the average amount of sleep reported by each participant along with their average score on the alertness scale on a graph to examine the data. The resulting correlation coefficient for Dr. Tabor’s data was +0.89. Define each of the following terms and explain how each concept might apply to Dr. Tabor’s research:

- **Random sample**
- **Scatterplot**
- **Wording effects**
- **Positive correlation**
- **Operational definition**

*(10 points)*

3. Find at least five problems in the research study described below. Identify the problem and explain how it is a violation of accepted research principles.

Dr. Pauling wanted to study whether vitamin C affects self-esteem. She recruited 200 respondents who arrived at her lab. Participants were told that they were about to participate in a harmless research study, and they needed to sign a release form in case there were harmful side effects from the vitamin C pills. The 100 participants on the right side of the room received a pill with vitamin C and the others on the left received a pill with caffeine. She then gave each group a list of questions to answer in essay form about their self-esteem. When they were finished, she thanked the participants and sent them on their way. After compiling her findings, Dr. Pauling printed the names of the students and their results in the campus newspaper so they would know what the results of the test were. Dr. Pauling concluded that vitamin C had a positive affect on self-esteem.

*(5 points)*