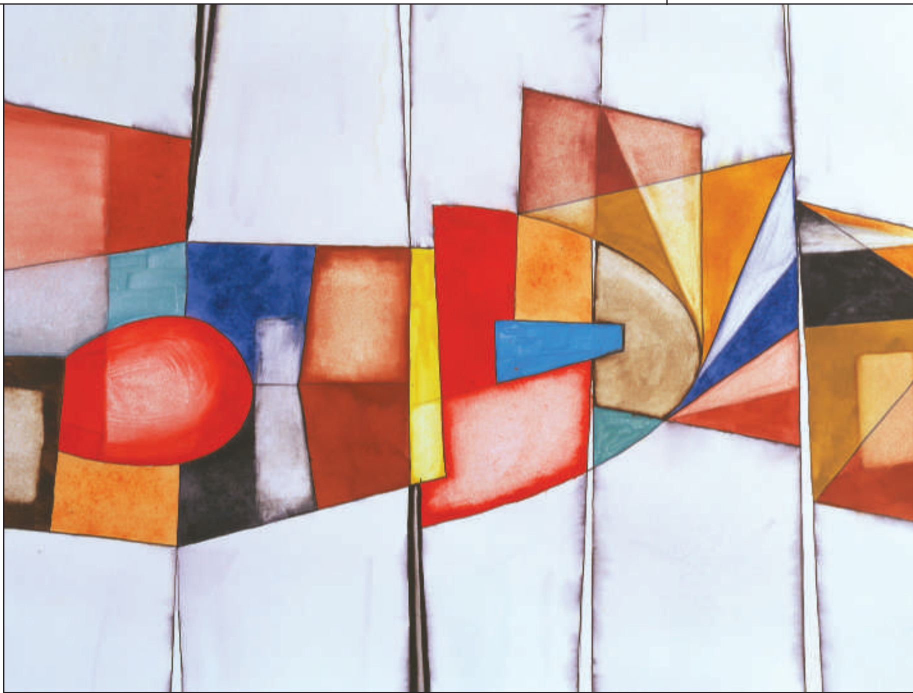
CHAPTER

12

The Correlational Research Strategy



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CHAPTER LEARNING OBJECTIVES

LO1 Define the goal or purpose of the correlational research strategy and distinguish between a correlational study and experimental and differential research.

LO2 Explain how a correlation describes the direction, form, and strength of a relationship and identify these characteristics for a set of data, especially data presented in a scatter plot.

LO3 Identify the statistical procedure used to determine a correlation for different types of data and explain what each correlation measures.

LO4 Describe how correlations are used for prediction, measuring reliability and validity of measurement, and evaluating theories.

LO5 Describe the strengths and weaknesses of the correlational research strategy including the third-variable problem and the directionality problem, and identify these problems when they appear in a research study.

CHAPTER OVERVIEW

As part of a large study concerning the health and well-being of undergraduate students, Lederer, Autr, Day, and Oswalt (2015) examined how work hours are related to sleep and feelings of being overwhelmed. The students reported the number of hours spent at work each week as well as the number of days they had enough sleep to feel rested and how often they felt overwhelmed. Not surprisingly, the results showed that increased hours at work was related to a decreased amount of sleep but that increased hours of work was related to an increased likelihood of feeling overwhelmed. For each relationship, notice that the data consist of two scores for each individual in a single group of participants; for example, a work score and a sleep score for each person are used to determine the relationship between work and sleep. This kind of study is an example of the correlational research strategy. In this chapter, we discuss the details of the correlational research strategy, discuss its strengths and weaknesses, and describe several specific applications.

12.1 An Introduction to Correlational Research

LEARNING OBJECTIVE

LO1 Define the goal or purpose of the correlational research strategy and distinguish between a correlational study and experimental and differential research.

In Chapter 6, we identified five basic research strategies for investigating variables and their relationships: experimental, nonexperimental, quasi-experimental, correlational, and descriptive. In this chapter, we deal with the details of the **correlational research strategy.** (The experimental strategy is discussed in Chapter 7, the nonexperimental and quasi-experimental strategies are discussed in Chapter 10, and details of the descriptive strategy are discussed in Chapter 13.)

A correlational study can involve measuring more than two variables but usually involves relationships between two variables at a time.

The goal of the correlational research strategy is to examine and describe the associations and relationships between variables. More specifically, the purpose of a correlational study is to establish that a relationship exists between variables and to describe the nature of the relationship. Notice that the correlational strategy does not attempt to explain the relationship and makes no attempt to manipulate, control, or interfere with the variables.

The data for a correlational study consist of two or more measurements, one for each of the variables being examined. Usually, the scores are obtained from the same individual. For example, a researcher might record on-task behavior and grades for each child in a classroom of elementary school students. Or a researcher could record food consumption and activity level for each animal in a colony of laboratory rats. Measurements can be made in natural surroundings or the individuals can be measured in a laboratory setting. The important factor is that the researcher simply measures the variables being studied. The measurements are then examined to determine whether they show any consistent pattern of relationship.

DEFINITIONS

> In the **correlational research strategy,** two or more variables are measured to obtain a set of scores (usually two scores) for each individual. The measurements are then examined to identify any patterns of relationship that exist between the variables and to measure the strength of the relationship.

For example, in Chapter 6, we described a correlational study by Junco (2015) examining the relationship between GPA and time spent on Facebook for college students (p. 131 and Figure 6.2). The researchers measured the grade point average and Facebook time for each individual in a group of college students and found that larger amounts of time spent on Facebook were consistently related to lower grade point averages. Although the study demonstrated a relationship between the two variables, it does not explain why the relationship exists. Specifically, the results do not justify a conclusion that time spent on Facebook causes lower grades (or that lower grades cause students to spend more time on Facebook).

In the definition of correlational research, we state that a correlational study usually obtains two or more scores for each individual. Usually, the word *individual* refers to a single person. However, the individual is intended to be a single source, not necessarily a single person. For example, several studies have demonstrated a relationship between family income and children's academic performance (for example, Elstad & Bakken, 2015). In general, higher family income is associated with higher grades. Note that the researchers have two scores for each child, however, one score comes from the parents and one from the child. In this case, each *individual* is a family rather than a single person.

Comparing Correlational, Experimental, and Differential Research

In Chapter 7 (p. 159), we noted that the goal of an experimental study is to demonstrate a cause-and-effect relationship between two variables. To accomplish this goal, an experiment requires the manipulation of one variable to create treatment conditions and the measurement of the second variable to obtain a set of scores within each condition. All other variables are controlled. The researcher then compares the scores from each treatment with the scores from other treatments. If there are differences between treatments, the researcher has evidence of a causal relationship between variables. Specifically, the researcher can conclude that manipulating one variable causes changes in the second variable. Note that an experimental study involves measuring only one variable and looking for differences between two or more groups of scores.

A correlational study, on the other hand, is intended to demonstrate the existence of a relationship between two variables. Note that a correlational study is not trying to explain the relationship. To accomplish its goal, a correlational study does not involve manipulating, controlling, or interfering with variables. Instead, the researcher simply measures two different variables for each individual. The researcher then looks for a relationship within the set of scores.

In Chapter 10 (p. 245), we noted that differential research, an example of a nonexperimental design, is very similar to correlational research. The difference between these two research strategies is that a correlational study views the data as two scores, X and Y, for each individual, and looks for patterns within the pairs of scores to determine whether there is a relationship. A differential design, on the other hand, establishes the existence of a relationship by demonstrating a difference between groups. Specifically, a differential design uses one of the two variables to define groups of participants and then measures the second variable to obtain scores within each group. For example, a researcher could divide a sample of students into two groups corresponding to high and low self-esteem, and then measure academic performance scores in each group. If there is a consistent difference between groups, the researcher has evidence for a relationship between self-esteem and academic performance. A correlational study examining the same relationship would first measure a self-esteem score and an academic performance score for each student, and then look for a pattern within the set of scores. Note that the correlational study involves one group of participants with two scores for each individual. The primary focus of the correlational study is on the relationship between the two variables. The differential study involves two groups of scores and focuses on the difference between groups. However, both designs are asking the same basic question: "Is there a relationship between self-esteem and academic performance?"

LEARNING CHECK

1. Which of the following is a defining characteristic of the correlational research strategy?
   a. The research is conducted in field settings rather than in a laboratory.
   b. The intent is simply to describe behaviors.
   c. The intent is to demonstrate the relationship between variables.
   d. The other three options are all defining characteristics of the correlational study
2. Which of the following commonly occurs in a correlational study?
   a. One variable is measured.
   b. Two variables are measured.
   c. One individual is described in great detail.
   d. One individual is treated.
3. A researcher would like to examine the relationship between self-esteem and academic performance for high school students. Instead of a correlational study, what other kind of study could the researcher use?
   a. A differential study comparing academic performance scores for a group of high self-esteem students and a group of low self-esteem students
   b. An experimental study comparing academic performance scores for a group of high self-esteem students and a group of low self-esteem students
   c. A descriptive study examining self-esteem for a group of students who are in the top 25% of their high school class
   d. None of the other options could be used to examine the relationship

Answers appear at the end of the chapter.

12.2 The Data and Statistical Analysis for Correlational Studies

LEARNING OBJECTIVES

LO2 Explain how a correlation describes the direction, form, and strength of a relationship and identify these characteristics for a set of data, especially data presented in a scatter plot.

LO3 Identify the statistical procedure used to determine a correlation for different types of data and explain what each correlation measures.

A correlational research study produces two or more scores for each individual. However, researchers are usually interested in the relationship between two variables at a time. Therefore, multiple scores are typically grouped into pairs for evaluation. In this section, we focus on relationships between pairs of scores. Relationships among multiple variables are discussed in Section 12.4.

Evaluating Relationships for Numerical Scores (Interval or Ratio Scales) and Ranks (Ordinal Scale)

When the data consist of numerical values, the scores in each pair are traditionally identified as *X* and *Y*. The data can be presented in a list showing the two scores for each individual or the scores can be shown in a graph known as a **scatter plot.** In the scatter plot, each individual is represented by a single point with a horizontal coordinate determined by the individual's *X* score and the vertical coordinate corresponding to the *Y* value. Figure 12.1 shows hypothetical data from a correlational study presented as a list of scores and as a scatter plot. The benefit of a scatter plot is that it allows you to see the characteristics of the relationship between the two variables.

Researchers typically calculate a numerical value known as a **correlation**, or **correlation coefficient**, to measure and describe the relationship between two variables. A correlation describes three characteristics of a relationship.

1. *The direction of the relationship.* In Figure 12.1, there is a clear tendency for individuals with larger *X* values to also have larger *Y* values. Equivalently, as the *X* values get smaller, the associated *Y* values also tend to get smaller. A relationship of this type is called a **positive relationship**. For example, there is a positive relationship between height and weight for college students; taller students also tend to weigh more. Positive relationships are indicated by positive values (greater than zero) for the correlation. In a scatter plot, a positive relationship is indicated by data points that cluster around a line that slopes up to the right. On the other hand, a relationship in which *X* and *Y* tend to change in opposite directions (as *X* increases, *Y* decreases) is called a **negative relationship**. On most performance tasks, for example, there is a negative relationship between speed and accuracy; going faster tends to result in lower accuracy. Negative relationships are indicated by negative values (less than zero) for the correlation. In a scatter plot, a negative relationship is indicated by data points that cluster around a line that slopes down to the right.

DEFINITIONS

In a **positive relationship,** there is a tendency for two variables to change in the same direction; as one variable increases, the other also tends to increase.

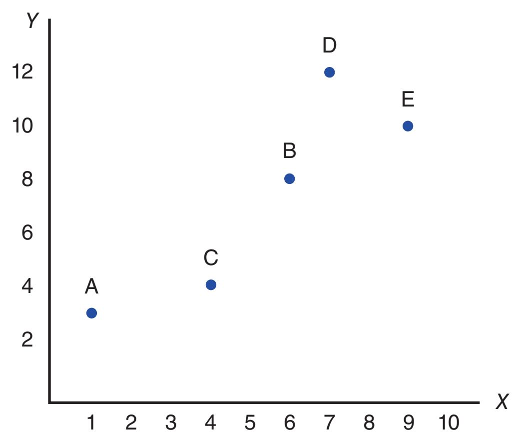
In a **negative relationship,** there is a tendency for two variables to change in opposite directions; increases in one variable tend to be accompanied by decreases in the other.

FIGURE 12.1

Data from a Correlational Study

Two scores, *X* and *Y*, for each of five people are shown in a table and in a scatter plot.

Person	*X*	*Y*
A	1	3
B	6	8
C	4	4
D	7	12
E	9	10



2. *The form of the relationship.* Typically, researchers are looking for a pattern in the data that suggests a consistent and predictable relationship between the two variables. In most situations, researchers look for a **linear relationship,** in which the data points in the scatter plot tend to cluster around a straight line. In a positive linear relationship, for example, each time the *X* variable increases by 1 point, the *Y* variable also increases, and the size of the increase is a consistently predictable amount. Figure 12.2a shows an example of a positive linear relationship. A **Pearson correlation** is used to describe and measure linear relationships when both variables are numerical scores from interval or ratio scales (see Chapter 15, pp. 384–387).

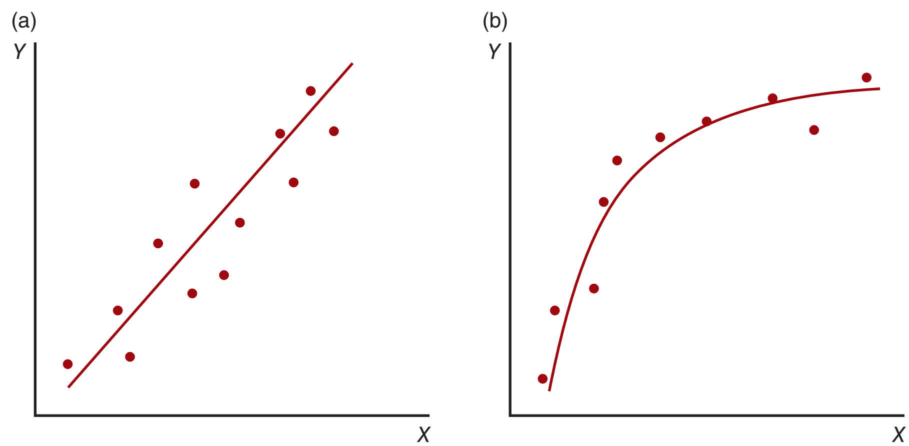
    It is possible for a relationship to be consistent and predictable, but not linear. For example, there tends to be a consistent relationship between practice and performance; for most skills, increased practice leads to improved performance. However, the amount of improvement is not constant from one week to another, so the relationship is not linear. During the first few weeks of practice, the increases in performance are large. However, after years of practice, one more week produces a hardly noticeable change in performance. A relationship that is consistently one-directional, either consistently positive or consistently negative, is called a **monotonic relationship**. In a positive monotonic relationship, for example, increases in one variable tend to be accompanied by increases in the other variable. However, the amount of increase need not be constantly the same size. Figure 12.2b shows an example of a positive monotonic relationship similar to the practice and performance example. A **Spearman correlation** is used to measure and describe monotonic relationships when both variables are ranks from an ordinal score or have been transformed to ranks (see Chapter 15, pp. 384–387).
3. *The consistency or strength of the relationship.* You may have noticed that the data points presented in Figure 12.2 do not form perfectly linear or perfectly monotonic relationships. In Figure 12.2a, the points are not perfectly on a straight line and in Figure 12.2b, the relationship is not perfectly one directional (there are reversals in the positive trend). In fact, perfectly consistent relationships are essentially never found in real behavioral sciences data. Instead, real data show a degree of consistency. In correlational studies, the consistency of a relationship is typically measured and

FIGURE 12.2

Linear and Monotonic Relationships

(a) An example of a linear relationship. The data points cluster around a straight line.

(b) An example of a monotonic relationship. The data points show a one-directional trend; as the *X* values increase from left to right, the *Y* values also tend to increase from bottom to top.



described by the numerical value obtained for a correlation coefficient. A correlation of +1.00 (or –1.00) indicates a perfectly consistent relationship, and a value of zero indicates no consistency whatsoever. Intermediate values indicate different degrees of consistency. For example, a Pearson correlation coefficient of 0.8 (or –0.8) indicates a nearly perfect linear relationship in which the data points cluster closely around a straight line. Each time the value of *X* changes, the value of *Y* also changes by a reasonably predictable amount. By contrast, a correlation of 0.2 (or –0.2) describes a relationship in which there is only a weak tendency for the value of *Y* to change in a predictable manner when the value of *X* changes. In this case, the data points are widely scattered around a straight line. Note that the sign of the correlation (+/–) and the numerical value are independent. A correlation of +0.8 has the same degree of consistency as a correlation of –0.8, and both correlations indicate that the data points cluster closely around a straight line; the lines simply tilt in different directions. Figure 12.3 shows a series of scatter plots demonstrating different degrees of linear relationship and the corresponding correlation values. As a final point, we should note once again that a correlation coefficient simply *describes* the consistency or strength of a relationship between variables. Even the strongest correlation of 1.00 (or –1.00) does not imply that there is a cause-and-effect relationship between the two variables.

DEFINITION

A **correlation**, or **correlation coefficient**, is a numerical value that measures and describes the relationship between two variables. The sign of the correlation (+/–) indicates the direction of the relationship. The numerical value of the correlation (0.0 to 1.0) indicates the strength or consistency of the relationship. The type of correlation (Pearson or Spearman) indicates the form of the relationship.

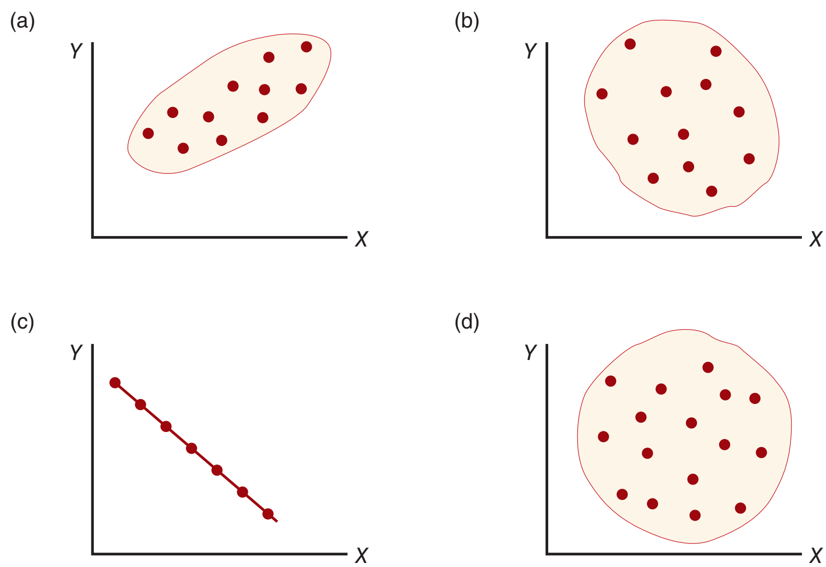
Evaluating Relationships for Non-Numerical Scores from Nominal Scales

Occasionally, a correlational research study produces two or more scores for each individual with at least one score that does not consist of numerical values. For example, a researcher may be interested in the relationship between college (college graduate/no

FIGURE 12.3

Examples of Different Degrees of Linear Relationship

(a) A strong positive correlation, approximately +0.90; (b) a relatively weak negative correlation, approximately –0.40; (c) a perfect negative correlation, –1.00; (d) no linear trend, a correlation of 0. In all graphs, the *X* values increase from left to right, and the *Y* values increase from bottom to top.



college) and success on a problem-solving task (succeed/fail). In this case, there are two measurements for each individual, but neither is a numerical score suitable for computing a correlation. In this situation, there are several alternatives for evaluating the relationship.

1. If one of the scores is numerical, like IQ, and the other is non-numerical, like college, the most common strategy is to use the non-numerical variable to organize the scores into separate groups. For this example, the data would consist of a group of IQ scores for the college graduates and a group of scores for people without college. The two groups are then compared using an independent-measures *t* test (for two groups) or an analysis of variance (for more than two groups). These hypothesis tests are discussed in Chapter 15 (see pp. 409–410). Note that when the data are organized into groups of scores, the research strategy is generally considered to be nonexperimental rather than correlational (see p. 297).

   If the non-numerical variable consists of exactly two categories, it is also possible to calculate a special correlation. First, the two categories are numerically coded as 0 and 1. For example college graduate = 0 and no college = 1. The data then consist of two scores per person, an IQ score and a coded score for college, and the Pearson correlation can be computed for the coded data. The resulting correlation is called a *point-biserial* correlation. The numerical value of the correlation is a measure of the strength or consistency of the relationship; however, the sign of the correlation is meaningless (because 0 and 1 are assigned arbitrarily), and the concept of a linear relationship is not meaningful (because the scores are simply separated into two groups).
2. If both variables are non-numerical, the relationship is typically evaluated by organizing the data in a matrix, with the categories of one variable forming the rows and the categories of the second variable forming the columns. Each cell of the matrix shows the frequency or number of individuals in that cell and the data are evaluated using a chi-square hypothesis test (see Chapter 15, p. 406). Figure 12.4 shows an example of data from a study examining the relationship between college experience and success on a problem-solving task.

   If the two non-numerical variables both consist of exactly two categories, each can be numerically coded as 0 and 1. For example, college graduate = 0 and no college = 1; failure = 0 and success = 1. If the Pearson correlation is computed for the coded data, the result is known as the *phi-coefficient*. The numerical value of the correlation measures the strength or consistency of the relationship, but the sign of the correlation and the concept of a linear relationship are not meaningful.

	Succeed	Fail
College Graduate	17	3
No College	12	8

FIGURE 12.4

Results from a Study Examining the Relationship between College and Success on a Problem-Solving Task

The values are the number of individuals in each category; for example, 12 of the college graduates successfully completed the task and 8 failed.

Interpreting and Statistically Evaluating a Correlation

For both numerical and non-numerical data, the value of a correlation, which ranges from 0.00 to 1.00, describes the consistency of the relationship with 1.00 (or –1.00) indicating a perfectly consistent relationship and 0.00 indicating a complete lack of consistency. However, there are two additional factors that must be considered when interpreting the strength of a relationship. One is the coefficient of determination, which is obtained by squaring the correlation, and the other is the significance of the correlation. Each of these factors is discussed in the following sections.

The Strength of a Relationship

The most common technique for measuring the strength of the relationship between two variables is to compute the **coefficient of determination**, which is obtained by squaring the numerical value of the correlation. Because a correlation is typically identified by the letter r, the coefficient of determination is r^2. This coefficient measures how much of the variability in one variable is predictable from its relationship with the other variable. For example, if two college students are randomly selected, they will almost certainly have different grade point averages. Although there are many explanations for different grades, one possibility is that the two students have different IQs. In general, there is a tendency for higher IQs to correlate with higher grades. If the correlation between IQ and grade point average is calculated and then squared, the result provides a measure of how much of the differences in grade point averages can be predicted by IQ scores. A correlation of $r = 0.80$ would mean that $r^2 = 0.64$ (or 64%) of the differences in grade point average can be predicted by difference in IQ. A correlation of $r = 0.30$ would mean that only 0.09 (9%) of the differences are predictable.

DEFINITION

> The **coefficient of determination** is the squared value of a correlation and measures the percentage of variability in one variable that is determined, or predicted, by its relationship with the other variable.

In the behavioral sciences, the differences that exist from one individual to another tend to be large and are usually difficult to predict or explain. As a result, the ability to predict only a small portion of the differences in behavior is typically considered a major accomplishment. With this in mind, the guidelines in Table 12.1 are commonly used to interpret the strength of the relationship between two variables (Cohen, 1988).

We should note that the values in Table 12.1 are a general guide for interpreting the correlations obtained in most behavioral science research. There are some situations, however, in which a correlation of 0.50 would not be considered to be large. For example, when using correlations to measure the reliability of measurement, researchers usually

TABLE 12.1

Guidelines for Interpreting the Strength of a Correlation

Degree of Relationship	Value of the Correlation Coefficient, or Coefficient of Determination
Small	$r = 0.10$ or $r^2 = 0.01$ (1%)
Medium	$r = 0.30$ or $r^2 = 0.09$ (9%)
Large	$r = 0.50$ or $r^2 = 0.25$ (25%)

look for large values, typically much greater than $r = 0.50$. Similarly, a research study that finds a theoretically important relationship between two variables might view a "small" correlation of $r = 0.10$ as a substantial relationship.

The Significance of a Relationship

The **statistical significance of a correlation** is the second important factor for interpreting the strength of a correlation. In the context of a correlation, the term *significant* means that a correlation found in the sample data is very unlikely to have been produced by random variation. Instead, whenever a sample correlation is found to be significant, you can reasonably conclude that it represents a real relationship that exists in the population.

With a small sample, it is possible to obtain what appears to be a very strong correlation when, in fact, there is absolutely no relationship between the two variables being examined. For example, with a sample of only two individuals, there are only two data points, and they are guaranteed to fit perfectly on a straight line. Thus, with a sample of two individuals, you will always obtain a perfect correlation of 1.00 (or –1.00) no matter what variables you are measuring. As the sample size increases, it becomes increasingly more likely that the sample correlation accurately represents the real relationship that exists in the population. A correlation found in a relatively large sample is usually an indication of a real, meaningful relationship and is likely to be significant. You should be warned, however, that a statistically significant correlation does not necessarily mean that the correlation is large or strong. With a very large sample, for example, it is possible for a correlation of $r = 0.10$ or smaller to be statistically significant. Clearly, this is not a strong correlation. (See Appendix B, p. 470 for additional information concerning the significance of a correlation.)

LEARNING CHECK

1. A college professor reports that students who finish exams early tend to get better grades than students who hold on to exams until the last possible moment. The correlation between exam score and amount of time spent on the exam is an example of
   a. a positive correlation.
   b. a negative correlation.
   c. a correlation near zero.
   d. a correlation near one.
2. A researcher reports that there is no consistent relationship between grade point average and the number of hours spent studying for college students. Which of the following is the best description for the correlation between grade point average and the number of hours studying?
   a. A positive correlation
   b. A negative correlation
   c. A correlation near zero
   d. A correlation near one
3. What is measured by the Pearson correlation?
   a. The degree of relationship without regard to the form of the relationship
   b. The degree to which the relationship is consistently one directional
   c. The degree of linear relationship
   d. The degree of curvilinear relationship

Answers appear at the end of the chapter.

12.3 Applications of the Correlational Strategy

LEARNING OBJECTIVE

LO4 Describe how correlations are used for prediction, measuring reliability and validity of measurement, and evaluating theories.

As noted earlier, the correlational design is used to identify and describe relationships between variables. Following are three examples of how correlational designs can be used to address research questions.

Prediction

One important use of correlational research is to establish a relationship between variables that can be used for purposes of prediction. For example, research shows a good positive relationship between SAT scores and future grade point average in college (Camera & Echternacht, 2000; Geiseer & Studley, 2002). College administrators can use this relationship to help predict which applicants are most likely to be successful students. High school students who do well on the SAT are likely to do well in college, and those who have trouble with the SAT are likely to have difficulty in college classes.

The use of correlational results to make predictions is not limited to predictions about future behavior. Whenever two variables are consistently related, it is possible to use knowledge of either variable to help make predictions about the other. For example, because there is a consistent, positive relationship between parents' IQs and their children's IQs, we can use either score to predict the other. Specifically, parents with above-average IQs are likely to have children with above-average IQs. Often, one of the two variables is simply easier to measure or more readily available than the other. In these situations, it is possible to use the available knowledge of one variable to predict the value of the unavailable variable. By establishing and describing the existence of a relationship, correlational studies provide the basic information needed to make predictions.

Within a correlational study, the two variables being examined are essentially equivalent. Nonetheless, correlational studies often identify one variable as the **predictor variable** and the second variable as the **criterion variable**. In a correlational study used for prediction, the designation of the two variables is usually quite clear. University admissions offices occasionally use the graduate record exam (GRE) scores to predict graduate school success. In this situation, the GRE scores are the predictor variable, and graduate performance is the criterion variable. Clearly, one variable (the predictor) is used to predict the other (the criterion).

The statistical process for using one variable to predict another is called **regression.** Typically, the goal is to find the equation that produces the most accurate predictions of Y (the criterion variable) for each value of X (the predictor variable). In a recent study, for example, regression was used to demonstrate that higher positive affect (low depression score) predicts better problem-solving ability for older adults (Paterson, Yeung, & Thornton, 2016).

In situations in which a correlational study is not used for prediction, researchers still tend to refer to a predictor and a criterion variable. In these situations, the labels are usually determined by the purpose of the study. Typically, a correlational study begins with one of the two variables relatively simple and well defined, and the second variable is relatively complex or unknown. Thus, the purpose of the study is to gain a better understanding of the complex variable by demonstrating that it is related to an established, known variable. In this situation, the known variable is designated as the predictor and the unknown variable as the criterion. For example, researchers are constantly looking for environmental and genetic factors that are related to the risk of Alzheimer's disease to gain a better understanding of this complex disorder.

DEFINITIONS

> When a correlational study demonstrates a relationship between two variables, it allows researchers to use knowledge about one variable to help predict or explain the second variable. In this situation, the first variable is called the **predictor variable** and the second variable (being explained or predicted) is called the **criterion variable**.

Reliability and Validity

In Chapter 3 (p. 56), the concepts of reliability and validity were introduced as the two basic criteria for evaluating a measurement procedure. In general terms, reliability evaluates the consistency or stability of the measurements, and validity evaluates the extent to which the measurement procedure actually measures what it claims to be measuring. Both reliability and validity are commonly defined by relationships that are established using the correlational research design. For example, test–retest reliability is defined by the relationship between an original set of measurements and a follow-up set of measurements. If the same individuals are measured twice under the same conditions, and there is a consistent relationship between the two measurements, then the measurement procedure is said to be reliable.

The concurrent validity of a measurement procedure can also be defined in terms of a relationship (see Chapter 3, p. 59). If a new test is developed to detect early-stage Alzheimer's disease, for example, the validity of the test can be established by demonstrating that the scores from the test are strongly related to scores from established tests. This is exactly what was done by Ijuin et al. (2008) to validate a relatively new 7-minute test that was developed as an alternative to other commonly used screening tests for Alzheimer's. Correlations were computed to measure the relationship between the scores from the 7-Minute Screen and the scores from each of the three established cognitive tests for Alzheimer's. The researchers obtained a correlation of around 0.70 for each test, indicating a strong positive relationship and high concurrent validity between the 7-Minute Screen and established screening tests.

Evaluating Theories

Many theories generate research questions about the relationships between variables that can be addressed by the correlational research design. A good example comes from the age-old nature/nurture question as it applies to intelligence: "Is intelligence primarily an inherited characteristic, or is it primarily determined by environment?" A partial answer to this question comes from correlational studies examining the IQs of identical twins separated at birth and placed in different environments. Because these twins have identical heredity and different environments, they provide researchers with an opportunity to separate the two factors. The original work in this area, conducted by British psychologist Cyril Burt, showed a strong relationship between the twins' IQs, suggesting that hereditary factors overwhelmed environment (Burt, 1972). However, later evidence showed that Burt probably falsified much of his data (Kamin, 1974). Nonetheless, correlational results suggest a strong relationship between twins' IQs. Note that the correlational research design is being used to address a theoretical issue.

LEARNING CHECK

1. Dr. Jones hopes to demonstrate that children who eat a more nutritious breakfast tend to have more academic success than their peers. If this result is obtained, then ______________ would be the predictor variable and __________ would be the criterion variable for the study.
   a. the nutrition in the breakfast; the level of success
   b. the level of success; the nutrition in the breakfast
   c. those who eat a high nutrition breakfast; those who eat a low nutrition breakfast
   d. the children; the level of success
2. Which research design is commonly used to help establish the reliability or validity of a measurement procedure?
   a. The observational research design
   b. The survey research design
   c. The case study design
   d. The correlational design
3. A researcher uses a correlation to demonstrate that a new 5-minute test for intelligence produces scores that are strongly related to the scores from traditional IQ tests. What is the researcher attempting to demonstrate about the new 5-minute test?
   a. Reliability
   b. Validity
   c. A cause-and-effect relationship
   d. None of the above

Answers appear at the end of the chapter.

12.4 Strengths and Weaknesses of the Correlational Research Strategy

LEARNING OBJECTIVE

LO5 Describe the strengths and weaknesses of the correlational research strategy including the third-variable problem and the directionality problem and identify these problems when they appear in a research study.

The correlational research strategy is often used for the preliminary work in an area that has not received a lot of research attention. The correlational design can identify variables and describe relationships between variables that might suggest further investigation using the experimental strategy to determine cause-and-effect relationships. In addition, the correlational research design allows researchers an opportunity to investigate variables that would be impossible or unethical to manipulate. For example, a correlational study could investigate how specific behaviors or skills are related to diet deficiencies or exposure to pollution. Although it is possible and ethical to record diet deficiencies and environmental pollution as they exist naturally, it would not be ethical to create these conditions in the laboratory. Countless other variables such as family size, personality, alcohol consumption, level of education, income, and color preferences can be interesting topics for behavioral research but cannot be manipulated and controlled in an experimental research study. However, these variables can be easily measured and described in correlational research.

One of the primary advantages of a correlational study is that the researcher simply records what exists naturally. Because the researcher does not manipulate, control, or otherwise interfere with the variables being examined or with the surrounding environment, there is good reason to expect that the measurements and the relationships accurately reflect the natural events being examined. In research terminology, correlational studies tend to have high external validity. In general, a correlational study can establish that a relationship exists, and it can provide a good description of the relationship. However, a correlational study usually does not produce a clear and unambiguous explanation for the relationship. In research terminology, correlational studies tend to have low internal validity. In particular, two limitations arise in explanations of results from a correlational study.

The third-variable and directionality problems are discussed in more detail in Chapter 7, pp. 162–163.

1. *The third-variable problem.* Although a correlational study may establish that two variables are related, it does not mean that there must be a direct relationship between the two variables. It is always possible that a third (unidentified) variable is controlling the two variables and is responsible for producing the observed relation. As noted in Chapter 7 (p. 162), this is known as the **third-variable problem**. For example, sales figures show a positive relationship between temperature and ice cream consumption; as temperature increases, ice cream consumption also increases. Other research shows a positive relationship between temperature and crime rate (Cohn & Rotton, 2000). When the temperature increases, both ice cream consumption and crime rates tend to increase. As a result, there is a positive correlation between ice cream consumption and crime rate. However, no one would suggest that there is a direct relationship between ice cream sales and crime. Instead, a third variable—temperature—is responsible for the observed correlation (Figure 12.5).
2. *The directionality problem.* A correlational study can establish that two variables are related; that is, changes in one variable tend to be accompanied by changes in the other variable. However, a correlational study does not determine which variable is the cause and which is the effect. As noted in Chapter 7 (p. 163), this is known as the **directionality problem**. For example, Collins et al. (2004) found a relationship between exposure to sexual content on television and sexual behavior among adolescents. Given this relationship, it is tempting to conclude that watching sex on television causes adolescents to engage in sexual behavior. However, it is possible that the true causal relationship is in the opposite direction. Adolescents who tend to be

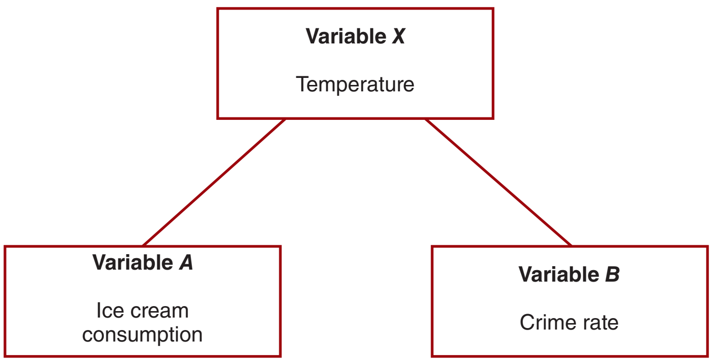


FIGURE 12.5

The Third-Variable Problem

Although ice cream sales (variable *A*) and crime rate (variable *B*) appear to vary together, there is no direct connection between these two variables. Instead, both are influenced by a third variable. In this example, the temperature (variable *X*) influences ice cream sales. In addition, temperature influences the crime rate.

sexually active could simply choose to watch television programs that are consistent with their own behaviors. In this case, sexual behavior causes the teenager to prefer television programs with sexual content (Figure 12.6).

The study linking sexual content on television and sexual behavior provides one more opportunity to discuss the fact that the correlational research strategy does not establish the existence of cause-and-effect relationships. The study consisted of a survey of 1,792 adolescents, 12–17 years of age, who reported their television viewing habits and their sexual behaviors. Notice that this is a correlational study; specifically, there is no manipulated variable. The title of the research report correctly states that watching sex on television *predicts* adolescent sexual behavior. However, when the study was presented in newspaper articles, it often was interpreted as a demonstration that sex on television *causes* adolescent sexual behavior. It was even suggested that reducing the sexual content of television shows could substantially reduce adolescent sexual behavior. As an analogy, consider the fact that the beginning of football season *predicts* the onset of fall and winter. However, no reasonable person would suggest that we could substantially postpone the change of seasons by simply delaying the opening day of football.

Table 12.2 summarizes the strengths and weaknesses of the correlational research design.

Relationships with More than Two Variables

Thus far, we only have considered correlational research in which the investigators are examining relationships between two variables. In most situations, however, an individual variable, especially a behavior, is related to a multitude of other variables. For example,

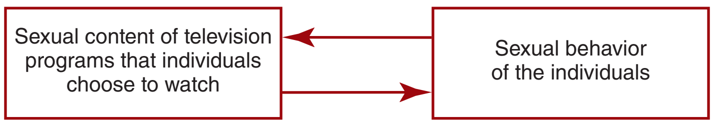


FIGURE 12.6

The Directionality Problem

Although a correlational study can demonstrate a relationship between the sexual content of television programs that adolescents watch and their sexual behaviors, the study cannot determine if the television content is influencing behavior or whether the behavior is influencing the choice of television programs.

TABLE 12.2

A Summary of the Strengths and Weaknesses of the Correlational Research Design

Strengths	Weaknesses
Describes relationships between variables	Cannot assess causality
Nonintrusive—natural behaviors	Third-variable problem
High external validity	Directionality problem
	Low internal validity

academic performance is probably related to IQ as well as to a number of other cognitive variables such as motivation, self-esteem, social competence, and a variety of other personal characteristics. One commonly used technique for studying multivariate relationships is a statistical procedure known as **multiple regression**. The underlying concept is that one criterion variable such as academic performance can be explained or predicted from a set of predictor variables such as IQ and motivation. IQ predicts part of academic performance, but you can get a better prediction if you use IQ and motivation together. For example, Collins and Ellickson (2004) evaluated the ability of four psychological theories to predict smoking behavior for adolescents in 10th grade. Although all four theories were good independent predictors, an integrated model using multiple regression to combine predictors from all four theories was more accurate than any of the individual models.

One interesting use of multiple regression is to examine the relationship between two specific variables while controlling the influence of other, potentially confounding variables. By adding predictor variables one at a time into the regression analysis, it is possible to see how each new variable adds to the prediction after the influence of the earlier predictors has already been considered. Earlier, we discussed a correlational study examining the relationship between adolescents' sexual behavior and the sexual content of the television programs they watch (Collins et al., 2004). Because the age of the participants ranged from 12 to 17 years, the researchers were aware that participant age could create a third-variable problem. Specifically, the older the participants are, the more likely it is that they watch television programs with sexual content and that they engage in sexual behaviors. Thus, the participants' age can create an artificial relationship between sexual content and sexual behavior; individuals who watch less sexual content tend to engage in less sexual behavior (the younger participants), and individuals who watch more sexual content tend to engage in more sexual behavior (the older participants). However, the researchers were able to use multiple regression to eliminate this problem. Sexual content of the television programs was entered into the regression equation after the effects of age (and other variables) had been removed. The results indicated that sexual content still was a significant predictor of adolescent sexual behavior.

As a final note, we should warn you that the language used to discuss and report the results from a multiple regression can be misleading. For example, you will occasionally see reports that the predictor variables *explained* the observed differences in the criterion variable. For example, a report might say that regression has demonstrated that variables such as intelligence, personality, and work drive *explain* differences in student grades. The truth is that the predictor variables only *predict* student grades; they do not really explain them. To get a cause-and-effect explanation, you must use the experimental research strategy. Unless a research study is using the experimental strategy (including manipulation and control), the best you can do is to describe relationships, not explain them.

LEARNING CHECK

1. The results from a correlational study show a positive relationship between aggressive behavior for 6-year-old children and the amount of violence they watch on television. Based on this relationship, which of the following conclusions is justified?

a. Decreasing the amount of violence that the children see on TV will reduce their aggressive behavior

b. Increasing the amount of violence that the children see on TV will increase their aggressive behavior

c. Children who watch more TV violence exhibit more aggressive behavior

d. All of the other options are justified conclusions

2. A researcher reports a positive relationship between sugar consumption and activity level for a group of 8-year-old children. However, the researcher cannot be sure whether the extra sugar is causing the children to be more active or whether the extra activity is causing the children to eat more sugar. Which of the following is demonstrated by this example?
a. The third-variable problem
b. The directionality problem
c. The reversal problem
d. The criterion problem

Answers appear at the end of the chapter.

CHAPTER SUMMARY

At this point, you should review the learning objectives presented at the beginning of each section and be sure that you have mastered each objective.

The goal of the correlational research strategy is to examine the relationship between variables and to measure the strength of the relationship. The data typically consist of measurements of two different variables for each individual. A graph of the data provides an opportunity to see the characteristics of the relationship (if one exists). Typically, researchers examine three characteristics of a relationship: the direction, the form, and the degree of consistency.

Correlational research can be used for prediction, to establish validity and reliability, and to evaluate theories. However, because of the third-variable and directionality problems, correlational research cannot be used to determine the causes of behavior.

The correlational research strategy is extremely useful as preliminary research and valuable in its own right as a source of basic knowledge. However, this strategy simply describes relationships between variables, and does not explain the relationships or determine their underlying causes.

KEY WORDS

correlational research strategy
positive relationship
negative relationship
correlation, or correlation coefficient
coefficient of determination
predictor variable
criterion variable

EXERCISES

The exercises are identified with specific learning objectives and are intended to assess your mastery of the objectives. You should be aware that exam items are also generated to assess learning objectives.

1. In addition to the key words, you should also be able to define each of the following terms:
scatter plot
linear relationship
Pearson correlation
monotonic relationship
Spearman correlation
statistical significance of a correlation
regression
third-variable problem
directionality problem
multiple regression
2. (**LO1**) Explain how the purpose of a correlational study differs from the purpose of an experimental study.
3. (**LO1**) Each of the following studies examines the relationship between sugar consumption and activity level for preschool children. Identify which is correlational, which is experimental, and which is nonexperimental.
Study 1: A researcher obtains a sample of 100 preschool children. Each child's parents are interviewed to determine the child's typical diet, and the child is

assigned a score describing the amount of sugar consumed daily. Also, the child's activity level is obtained from direct observation on the playground. The results show that higher sugar consumption tends to be associated with a higher level of activity.

Study 2: A researcher obtains a sample of 100 preschool children. The children are randomly assigned to two groups. On arriving at school each morning, one group is given a high-sugar breakfast, and the other group is given a breakfast relatively low in sugar. After 1 week, each child's activity level is measured by direct observation on the playground. On average, the children in the high-sugar breakfast group had a higher level of activity than the children in the low-sugar group.

Study 3: A researcher obtains a sample of 100 preschool children. Based on interviews with the parents, the children are divided into two groups corresponding to high-sugar and low-sugar diets. The children are then observed on the playground to obtain an activity-level score for each child. On average, the children in the high-sugar group had higher activity scores than the children in the low-sugar group.

4. (**LO2**) Describe the pattern that would appear in a scatter plot showing the data points for each of the following correlations: $r = -0.9$ and $r = +0.3$.

5. (**LO2**) Suppose that there is a negative relationship between grade point average and the number of hours spent playing video games for high school boys. What grades would you predict for boys who spend more than the average amount of time playing video games?

6. (**LO1** and **2**) The following list contains several variables that differentiate college students.
   a. Select two variables from the list that should have a consistent relationship (either positive or negative). Briefly describe how you would do a correlational study to evaluate the relationship.
   b. Describe how you would do a nonexperimental, differential research study to evaluate the same relationship (see Box 10.1, p. 245).

   physical attractiveness
   intelligence
   alcohol consumption
   shyness
   exam anxiety
   hours of sleep per night
   hours of television per week

7. (**LO3**) Explain the difference between a linear relationship and a monotonic relationship, and identify which correlation is used to measure each.

8. (**LO4**) Describe how the reliability of a personality test could be established using the results from a correlational study.

9. (**LO5**) Describe how the third-variable problem and the directionality problem limit the interpretation of results from correlational research designs.

LEARNING CHECK ANSWERS

Section 12.1
1. c, 2. b, 3. a

Section 12.2
1. b, 2. c, 3. c

Section 12.3
1. a, 2. d, 3. b

Section 12.4
1. c, 2. b