Chapter 4

Research Methods

The Scientific Method

As an empirical science, psychology requires verifiable and objective data obtained through the use of the **scientific method** for the development of knowledge. The steps in the scientific method are outlined in the chart below. Psychologists begin the research process by evaluating existing evidence in order to develop a **theory**, or organized explanation for data, gained through empirical processes. The scientific method also requires the development of a testable and falsifiable prediction explaining the relationship between variables known as a **hypothesis**.

To test the hypothesis, the experimenter must clearly define each of the procedures and variables being studied by creating operational definitions. **Operational definitions** state as precisely as possible what each variable means, including how it will be measured. The process of operationally defining variables is critical to the research process because it allows for **replication**, or having future psychologists repeat the exact procedures to obtain the same results. In order to reduce the risk that the results occurred by chance, all conclusions drawn from psychological research must be replicable.

Table 4.1. Steps of the Scientific Method

1	Theory	Organizing explanations of natural events in order to generate new hypotheses and make predictions or explain behavior.
2	Hypothesis	Generation of a specific prediction designed to test a theory often expressed in the form of an *"if . . . then"* statement.
3	Select method and design study	Utilizing controlled experiments, case studies, psychological tests, surveys, interviews, or naturalistic observation to compile data to increase or decrease support for a hypothesis.
4	Collect and analyze results	Statistically analyze collected data allowing for conclusions to be made regarding the hypothesis.
5	Publication of results	Report findings, usually in a scientific journal where the research will be subject to the critical evaluation of the scientific community.

Research Methods

As a science, psychology seeks to use empirical methods to observe and measure, predict, explain, and positively influence behavior. The descriptive methods relate to the functions of observation and measurement. Correlational studies make predictions, and experiments are designed to explain cause and effect relationships. When psychologists conduct **basic research,** the aim is to answer scientific questions and expand the overall information base of psychology. **Applied research** utilizes descriptive, correlational, and experimental designs to positively influence behavior and solve real-world problems.

Population vs. Sample

When conducting research, the experimenter must first identify a specific population to be studied, i.e., all Americans, all college students, or all female high school soccer players. The **population** includes all members of a group that could be selected for research and to whom the results apply. Because it is difficult or impossible to reach an entire population, psychologists select a **sample**, or small subset of individuals to represent the population.

STUDY TIP

Be able to distinguish the terms *population* and *sample* in an example.

It would be difficult and expensive to give a survey to every female high school soccer player in the United States (population), so researchers select several high school teams in each state (a sample) to represent the population.

Psychologists are concerned with ensuring that the results obtained from the sample are typical of the population, which makes the sample selection process an important part of the research design. Poor sample selection creates problems in generalizing the results to the population referred to as *sampling bias.* **Sampling bias** is any selection method resulting in a sample that is not representative of the population *or* that does not provide all of the members of a population an equal chance to be chosen for the study, which can result in distorted findings. For example, if the hypothesis states that high school students who watch television for more than twenty hours per week will have lower ACT scores than other students, the population would include all high school students that took the ACT. If the sample included only students from public

high schools, sampling bias would occur because students who attended private high schools or who were homeschooled were not eligible to be selected for the sample.

Research requires the reduction or elimination of sampling bias by obtaining random and representative samples. **Random samples** are designed so that every member of the population has an equal chance of being chosen for participation in the study. The various methods used to generate a random sample from a population are called **random selection** and can include placing the names of all of the participants in order alphabetically and then choosing every tenth name or by using a computer to generate random numbers for the participants. Random selection is a critical step in the research process because it increases the likelihood that the results of the research can be applied to the larger population. Psychologists also use random selection to increase the chances for obtaining a sample that is **representative** or similar to the population as a whole in regard to variables that might impact the results, such as gender, religious affiliation, income, and ethnicity. Experimenters also use stratified samples for large diverse populations to ensure representativeness. **Stratified samples** are created by dividing the population into subgroups (strata) to create a sample that contains members of each subgroup in the same proportion that exists in the larger population. For example, if the population consists of all of the students taking psychology courses at a particular university and the population is 60 percent female, then the stratified sample would also need to be 60 percent female. In terms of selecting participants for research, it is usually best to have a larger sample size in order to ensure that the subjects are representative of the population as a whole.

Descriptive Methods

Descriptive methods include a variety of research techniques designed to observe and measure behaviors and mental processes. These methods are valuable because they generate a broad viewpoint and indicate specific behaviors that deserve further exploration. The key factor that distinguishes descriptive methods from other research designs is that the experimenter does not manipulate the variables or the behavior of the participants. This means descriptive methods cannot be used to determine cause and effect relationships. The descriptive method of **naturalistic observation** involves carefully and systematically watching human or animal behavior as it occurs in the natural environment. Naturalistic observation allows researchers to determine what organisms actually do in the real world and discover clues as to why they do it. For example, when investigating whether or not students recycle, a researcher utilizing naturalistic observation would carefully watch students and systematically collect data regarding recycling behavior in the lunchroom.

Another descriptive method is the **survey,** whereby individuals are asked to reply to a series of questions or to rate their agreement with various statements. Surveys are designed to discover the beliefs, opinions, and attitudes of a sample in order to draw conclusions about the population. This method is used by consumer psychologists to help retail stores be successful by asking customers to call a toll-free number and answer a series of questions. The survey method is used by clinical psychologists to determine attitudes toward mental illness or the effectiveness of therapeutic methods.

Clinical psychologists and medical researchers utilize the **case study method** to conduct in-depth investigations of individuals or groups. Detailed information for case studies is compiled through the use of observation, interviews, surveys, and testing. This method is especially beneficial when researching rare behaviors or examining a problem or issue relevant to a particular person or group. Educational psychologists assist public school districts by employing the group case study method to identify why students are struggling in a particular subject area by examining test results and data obtained from detailed interviews with students and teachers. A famous example of an individual case study involved the subject referred to as patient H.M. who suffered from memory problems resulting from brain surgery to treat epilepsy. Although the surgery successfully eliminated the epileptic seizures, unfortunately it also resulted in severe and permanent amnesia. Case study research involving patient H.M. has helped psychologists gain a better understanding of how specific brain structures are involved in various memory processes. Case studies are beneficial because they allow for insight into rare behaviors and provide suggestions for further research.

Experimental Method

If researchers want to demonstrate cause and effect regarding a particular behavior, it is necessary to design an experiment. The first step is to randomly select participants from the population. The **participants** or subjects in an experiment consist of the humans or animals participating in the research. Participants in an experiment are exposed to some event, treatment, or condition that is being manipulated by the experimenter; this factor is called the **independent variable (IV)**. The observation and measurement of the behavior or mental process of participants in an experiment is called the **dependent variable (DV)**. Researchers look for differences between the dependent variable in the control and experimental groups to determine if the IV caused a change. In order to ensure that the experiment can be replicated, both the independent and dependent variables are operationally defined. When using the experimental method, psychologists create either an experimental or a null hypothesis which is a testable and

falsifiable prediction. The experimental **hypothesis** is a prediction of the exact outcome in terms of the effects on the DV that are caused by the IV. An experimental hypothesis might involve the prediction that if students listen to music while taking an exam, their test scores will improve. Researchers may also use a **null hypothesis** for the same experiment, which is a prediction that the IV will have no effect on the DV *or* that the findings resulted from chance. The null hypothesis for the previous example would be that listening to music while taking an exam will not improve student test scores *or* that any improvement in test scores would most likely be due to chance and not to the IV. It is always the goal of researchers to reject the null hypothesis, indicating that the IV caused a change in the DV.

STUDY TIP

Be able to identify the independent and dependent variables in a sample experiment.

A simple way to make identification of the variables in an experiment easier is to use the following steps:

1. Find the hypothesis and convert it into an *"if . . . then"* statement.
2. The IV is what comes after the *"if"* in the statement, indicating the cause of the behavior being studied.
3. The DV is what comes after the *"then"* in the statement, indicating the expected effect of the IV.

Example: Stephanie believes that walking briskly during passing periods will result in increased participation by students during class.

1. If students walk briskly during passing periods, then they will be more motivated in class.
2. "If . . . walk briskly" becomes the IV.
3. Then . . . "more motivated in class" becomes the DV.

In an experiment participants are placed into either a control group or an experimental group. The participants in the **experimental group (experimental condition)** receive the IV, but participants in the **control group (control condition)** are not exposed to the IV; they function as a comparison for evaluating the effectiveness of the factor being studied. By controlling all other variables, researchers work to ensure that the only difference between the two groups in the experiment is the presence of the IV. Any difference present other than the IV between the experimental or control group participants that might have an effect on the DV is considered to be a **confounding variable.** Researchers eliminate or control possible confounding variables because they prevent the researcher from being able to draw cause and effect conclusions.

STUDY TIP

Be able to differentiate between control within an experiment and the control group.

- Researchers exert *control* within an experiment by eliminating all differences between the two groups other than the IV. Experimenters control conditions by using such methods as obtaining a random sample, using random assignment, and standardizing procedures.
- The *control group* is the condition or subjects within the experiment that do not receive the IV; they will be used for comparison with the experimental group to determine if there is a cause and effect relationship.

Random assignment ensures that each participant has an equal chance of being assigned to either the experimental or control group. The process of random assignment is required in order to determine cause and effect and eliminate confounding variables. In contrast to the experimental method, **quasi-experimental** research does not include random assignment. In quasi-experiments, the difference between the experimental and control groups has been previously determined, because the variable being studied has already taken effect. In quasi-experiments researchers exert very little control and, as a result, cannot make cause and effect conclusions. Quasi-experimental designs are used because they may be more convenient, and they allow for the investigation of phenomena that participants could not be randomly assigned to experience because it would be unethical. For example, if researchers were interested in observing how poverty impacts success in school, a quasi-experimental design would be used, because it would be unethical or impossible to randomly assign participants to live in poverty.

STUDY TIP

Be able to distinguish between the terms *random selection of a random sample* and *random assignment.*

- *Random selection* involves choosing a *random sample* in which each member of the population has an equal chance of being selected for the sample.
- *Random assignment* involves placing participants into either the experimental or control group by chance and is required in order to determine if there is a cause and effect relationship.

Research Bias

Experimenter (researcher) bias is the tendency for researchers to unknowingly influence the results of an experiment. Because the researchers are aware of the hypothesis, they may unintentionally treat participants in a manner that confirms their predictions. **Participant bias** occurs when subjects know that they are being watched or recognizes what the experimenter is investigating. Potential hints or indications of what is being studied that might be discovered by participants are known as **demand characteristics** and can result is distorted findings.

Researchers may control for participant bias and demand characteristics by deceiving subjects in the control group with a fake treatment called a **placebo.** The classic example of a placebo involves giving members of the control group in a drug experiment a pill containing an inert substance (sugar pill), rather than the actual drug that is given to participants in the experimental group. The **placebo effect** occurs when a physical or psychological treatment that has no active ingredient produces an effect because the person receiving it believes that it will. Researchers control for the confounding variable created by the placebo effect by not letting subjects know whether they are receiving the actual treatment or a placebo. If subjects do not know whether they are receiving the drug (IV) or the placebo, the experiment is called a **single blind study** and controls for demand characteristics and the placebo effect. In a **double blind study** both the experimenter and the subjects are unaware of who has received the treatment (IV). Double blind studies eliminate both experimenter and participant bias.

STUDY TIP

Be able to identify the participants, variables, and groups within a sample experiment.

A researcher investigating the effects of listening to music while studying on test performance randomly assigns high school student participants to a music group or a quiet group while preparing for the test. The researcher subsequently compares the two groups' test scores using inferential statistics and concludes that p =.05.

- The *participants* in this study are high school students.
- The *independent variable* in this study is listening to music.
- The *dependent variable* in this study is test performance.
- The *control group* in this study consists of students randomly assigned to the quiet group for studying.
- The *experimental group* in this study consists of students randomly assigned to listen to music while studying.

Correlational Method

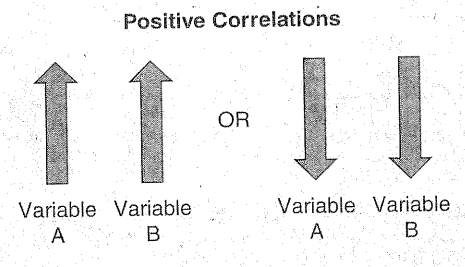
Correlational studies allow researchers to determine whether a relationship exists between two variables. Although correlational research cannot determine cause and effect, these studies illustrate the strength and direction of the relationship between variables, allowing for prediction.

The data used in the correlational method is collected through other research designs, such as surveys, interviews, and case studies. Even very strong correlations cannot be perceived as cause and effect relationships because it is possible that both variables are in fact caused by another additional factor in what is referred to as the **third-variable problem**. Variables may be found to be correlated either positively, or negatively. A **positive (direct) correlation** means that, as one variable increases, so does the second variable *or,* as one variable decreases, so does the other. In a positive correlation, both variables move in the same direction. For instance, the statement that the taller a person is, the larger his or her shoe size will be, indicates a positive correlation. This could also be stated as the shorter a person is, the smaller the shoe size will be. A **negative (inverse) correlation** means that high scores on one variable will be paired with low scores on the other variable. For example, if the data indicate that as age increases, eyesight deteriorates, this would be a negative correlation. In some cases, two variables are not related to each other at all, resulting in a **non-correlation**. Psychologists would be interested in examining data to determine if there is a correlation between playing violent video games and increased aggression in children. If children who played more violent video games were more aggressive, a positive correlation would exist between the two variables. Sometimes individuals identify an **illusory correlation**, an incorrect perception that two variables are related *or* an overestimation about the strength of the relationship.

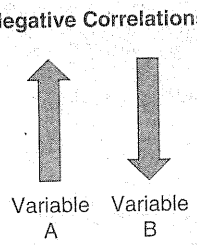
STUDY TIP

Be able to identify the direction of correlations.

- *Positive correlations identify a relationship between two variables that "go together."*

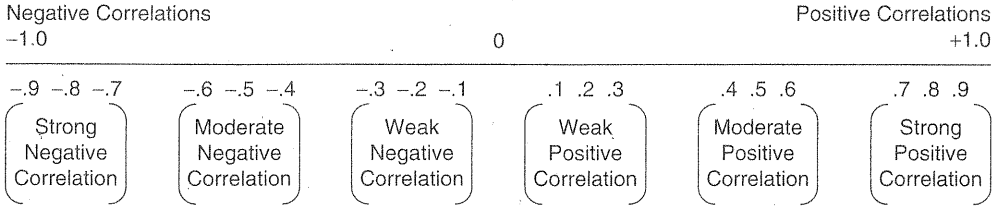


- *Negative correlations identify a relationship between two variables that "go in opposite directions."*



In addition to the direction of the relationship, correlational research determines the strength of the relationship between the variables through the use of a statistical concept known as a **correlation coefficient**. The most common example is the Pearson correlation coefficient represented by the letter *r* and ranging from −1.0 to +1.0. Higher values represent stronger relationships, or, put another way, the greater the number, the stronger the two variables are related either positively or negatively. For example, a correlation of −.73 is just as strong as a correlation of +.73; they differ only in the direction of the relationship. A correlation of −1.0 indicates a perfect negative correlation or a situation in which every time one variable increases, the other variable decreases. A correlation of +1.0 indicates a perfect positive correlation or a situation in which every time one variable increases, the other variable increases. Most correlations involving human behavior are not perfectly positive (+1.0) or negative (−1.0) correlations. For example, the variables of class attendance and exam scores are positively correlated. Students that have better attendance are more likely to have higher exam scores. Of course, there will be some students who might not have good attendance, but still do well on exams, resulting in a correlation between the variables of attendance and exam scores

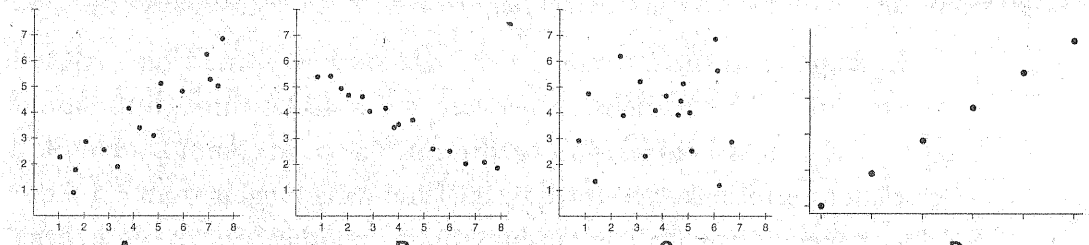
that is positive but not perfect. A correlation coefficient of 0 indicates that no relationship exists between the variables, and values closer to zero indicate weaker correlations.



The correlation between two or more variables is illustrated on a graph called a **scatterplot (scattergram).** Positive correlations create scatterplots where the data forms a curve or line going up and negative correlations create curves on a scatterplot that go down.

STUDY TIP

Be able to identify the direction and general strength of a correlation based on looking at a scatterplot. Scatterplots that create lines going from bottom to top (A and D) represent positive correlations, and patterns that go from top to bottom (B) represent negative correlations. The closer the collection of data points is to a straight line, the stronger the correlation (D). If there is no relationship between the variables (C), the points on the scatterplot do not create a pattern in either direction.



Advantages and Limitations of Research Methods

Based on the hypothesis and ethical concerns involved, psychologists choose from a variety of scientific methods to conduct research. If the goal of the research is to observe and measure behaviors and mental processes, researchers will select descriptive methods. Descriptive methods include naturalistic observation, surveys, and case studies. On the other hand, when psychologists are interested in predicting or explaining behaviors and mental processes, they will select either correlational or experimental methods. Descriptive, correlational, and experimental methods each have separate advantages and limitations.

STUDY TIP

Be able to describe each of the various research methods, including the advantages and limitations of each.

Table 4.2. Advantages and Limitations of Research Methods

Research Method	Purpose	Advantages and Limitations
Naturalistic Observation	Describe—designed to observe and measure	**Naturalistic Observation Advantages** • Allows researchers to observe behavior as it would occur in the real world **Naturalistic Observation Limitations** • Researcher cannot determine cause and effect. • Presence of the researcher may result in the participants altering their behaviors. • Observations made by researchers are subjective.
Survey	Describe—designed to observe and measure	**Survey Advantages** • Researchers can generate large amounts of data for comparison quickly and inexpensively. **Survey Limitations** • Researcher cannot determine cause and effect. • Difficulty in obtaining a random and representative sample • Data may be inaccurate due to intentional lying or inconsistencies between what participants say and what they do. • Data may be inaccurate, due to *social desirability bias* or the tendency for participants to not answer personal questions honestly in order to present themselves in a positive way. • Data may be inaccurate due to the wording of survey questions.
Case Study	Describe—designed to observe and measure	**Case Study Advantages** • Useful for examining rare behaviors in detail • Provide a starting point for developing hypotheses **Case Study Limitations** • Researcher cannot determine cause and effect. • Results are vulnerable to experimenter bias. • Sample size is too small to generalize results to the larger population. • Participants may quit at any time, thus ending the study.

(continued)

Table 4.2. (*Continued*)

Research Method	Purpose	Advantages and Limitations
Correlation	Predict—designed to describe a relationship	**Correlation Advantages** • Tests the strength of a relationship and allows for predictions to be made regarding two variables • Builds on existing knowledge gained through descriptive methods • Generates predictions for further experimental research **Correlation Limitations** • Researcher cannot determine cause and effect. • Difficulty in obtaining a random and representative sample
Experiment	Explain—designed to determine cause and effect	**Experiment Advantages** • Only method that can determine cause and effect **Experiment Limitations** • Confounding variables weaken cause and effect explanations. • Difficulty in obtaining a representative sample

Statistics

Psychologists use statistics both to describe the findings they collect and to make conclusions about behavior by converting the results into mathematical data. In order to be prepared for statistics on the AP Psychology Exam, be prepared to describe the purposes of descriptive and inferential statistics, interpret statistical significance, determine the strength and direction of correlations, and calculate measures of central tendency and simple standard deviations.

Levels of Measurement

Data collected from research falls into four types of measurement with varying levels of precision in terms of statistics. The four types in order from least to most precise are nominal, ordinal, interval, and ratio. A mnemonic to remember the four types of measurement is the French word for the color black (*noir*); the first letter of each of the four types of measurement spell the word *noir*.

Table 4.3. Types of Measurement

	Description	Examples	Limitations
Nominal Data	Data categorized to represent names or characteristics.	• Gender Female (1) Male (2) • Diagnosis Depression (1) Schizophrenia (2) Bipolar (3)	Nominal data will only provide a label and does not have any mathematical properties. Nominal data cannot be rank ordered or averaged; it can only be classified.
Ordinal Data	Data that indicates rank order.	• Finishing the football season in first place, second place, etc. • Subjects rate level of anxiety on a scale of 1–5.	Ordinal data does not indicate exact intervals and cannot be averaged. Numbers or variables can be seen only as more or less than others in the set.
Interval Data	Data that indicates the order in which figures can be ranked, as well as providing equal distances (intervals) between items. Equal spaces between points on a scale make it possible to know how much one score is greater than or less than another.	• Standardized tests for personality, anxiety, and IQ often use interval scales.	Interval scales do not have a true zero, or, in other words, a score of zero has meaning and does not represent absence of a score.
Ratio Data	Data that indicates equal intervals and the presence of a *true zero* (zero stands for a complete absence of what is being measured)	• Weight is ratio data because there is a true zero and ratios can be calculated. Ten pounds is twice as heavy as 5 pounds.	Ratio data is the most precise and allows for the best statistical analysis.

Descriptive Statistics

Descriptive statistics are used to illustrate data and include tables, graphs, charts, correlations, measures of central tendency, and variance. One specialized type of descriptive data in table form is a frequency distribution. **Frequency distributions** are tables that contain data about how often certain scores occur or how many subjects fit into each category; they are often used for nominal data. If a frequency distribution is displayed as a specialized type of bar graph, it is called a **frequency histogram,** and if the data is presented as a specific style of line graph, it is called a **frequency polygon**.

Measures of **central tendency** consist of various statistical procedures that describe the typical or central score within a data set. There are three main ways to measure central tendency: mean, median, and mode. The **mean** is the arithmetic average of a set of scores, and it is determined by computing the sum of all the scores and dividing the sum by the total number of scores in the distribution. The mean is the most commonly used measure of central tendency, but it is also the statistic most affected by extreme scores, known as outliers. The **median** is the score that falls in the exact middle of the distribution; half the scores fall above the median and half the scores fall below it. If a given data set contains an equal number of data points, the median is the average of the two middle scores. The main advantage of the median is that it is not sensitive to extreme scores or outliers. The **mode** is the most frequently occurring score. A distribution is considered **bimodal** if there are two separate scores that appear most frequently and **multimodal** if three or more scores occur most often.

STUDY TIP

Be able to compute measures of central tendency and variance for a simple series of scores.

Example

Sample Distribution: 37, 5, 3, 4, 6, 4, 5, 8

The first step is to place the distribution in numerical order: 3, 4, 4, 5, 5, 6, 8, 37

Measures of Central Tendency

- The *mode* is 4 and 5, because both numbers are the most frequent, resulting in a bimodal distribution.
- The *median* is 5. This distribution has an equal number of data points. To determine the median, compute the average between the two middle scores of 5 and 5.
- The *mean* is 9. The mean is the sum of all of the data points in this distribution, divided by eight, which is the total number of scores in the distribution.

In this example, the median is the most useful measure of central tendency because the mean is distorted by one extreme score (37).

Measures of Variability

- The *range* is 34, or the difference between the highest score (37) and the lowest score (3).
- The *standard deviation* is the $\sqrt{114}$ or 10.67.

Descriptive statistics also include measures of **variability** that indicate how much individual scores differ from each other and the average. The simplest measure of variability is the **range**, or the distance or spread between the highest and lowest scores in the distribution. Another measure of variability, **standard deviation,** is a mathematical

representation of how far on average each of the individual scores in a data set varies from the mean. In other words, the standard deviation is the average distance of each score from the mean. The steps for computing and interpreting standard deviations are presented in the table below.

Figure 4.1. Computing the Standard Deviation

1. Determine the mean for the distribution.
2. Determine the distance of each individual score from the mean.
3. Square each score that was found in step two.
4. Add all of the scores found in step three together.
5. Divide this number by the total number of scores in the distribution.

   Note: The result of step of five is a statistic called the *variance.*
6. The square root of the total from step five is the standard deviation.
   - Larger standard deviations indicate that scores are spread out farther from the mean.
   - Smaller standard deviations indicate that scores are located closer to the mean.
   - A standard deviation of 0 indicates that all scores in a distribution are equal.

Normal Distribution

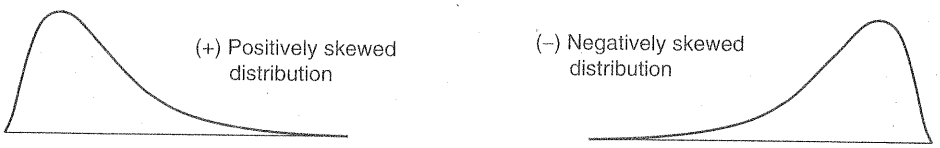
If the mean, median, and mode are all equal and located at the center of the distribution, the result is a **normal distribution (curve)** that forms a symmetrical bell curve. Many psychological characteristics, such as IQ or test scores, create normal distributions with predictable percentages of scores that fall between specific standard deviations. In a normal distribution, approximately 68 percent of scores fall within one standard deviation of the mean, 95 percent of scores fall within two standard deviations of the mean, and 99 percent of scores fall within three standard deviations of the mean.

Extreme Scores—Skewed Distributions

Not all data sets create normal distributions that form symmetrical bell curves. When most of the scores in a distribution land on one side of the scale or the other, they are considered skewed.

Skewed distributions are not symmetrical and are characterized by a "tail" on one end of the scale or on the other end. If a distribution is **positively skewed (right skewed)**, most of the scores will be low and the tail of the distribution will be pointing toward the right or positive side of the number line. If a distribution is **negatively skewed (left skewed)**, most of the scores will be high and the tail of the distribution will be pointing to the left or the negative portion of the number line.

Figure 4.2. Positively and Negatively Skewed Distributions



Positive or Right Skewed Distribution

Negative or Left Skewed Distribution

Inferential Statistics

When conducting an experiment, the researcher virtually always measures behavior in a sample (a representative subset) of people drawn from a larger population (such as all Americans or all college students). The scores for a particular sample can be summarized by using descriptive statistics. However, psychologists are rarely interested in only the data obtained from the sample. Researchers are more interested in what the data indicates for the population. For example, if the results of an experiment indicate that individuals in a sample who talked on a cell phone while driving a simulator were more likely to have accidents, would this be true for the population? Because most research is conducted with a sample that is much smaller than the population it represents, psychologists utilize inferential statistics to make inferences about the population.

Inferential statistics indicate whether or not results based on the sample are significant enough to be applied to the larger population or if the results were most likely caused by chance. Researchers evaluate the differences in the dependent variable between the control and experimental groups to determine if the difference is a result of the independent variable and not coincidence. Inferential statistics take into account the size and quality of the sample, as well as how large a difference exists between the dependent variables in the control and experimental groups. If a difference in the dependent variable between the control and experimental groups is **statistically significant,** it simply means that the results were *not likely* to have happened by chance. Statistical significance indicates a high probability that the independent variable caused the change in the dependent variable, allowing the researcher to reject the null hypothesis.

In order to understand statistical significance, keep in mind that any difference between two means (in an experiment) could have happened by chance. Researchers use

a variety of inferential statistics to determine statistical significance that include chi square tests, t-tests, and analyses of variance (ANOVAs) to generate a probability value (p). A *probability value (p)* is an inferential statistic that indicates how likely it is that the difference between the control and experimental groups was caused by chance and not the independent variable. In order for the results to be considered statistically significant, the p value must be $\leq .05$. If the results indicate that $p = .05$, the researcher believes that there was a 95 percent likelihood that the results were not due to chance. In other words, the researcher is 95 percent certain that the independent variable was responsible for the change in the dependent variable. It is important to note that a p value can never be zero because it is impossible to be 100 percent certain that the hypothesis is correct and that chance was not involved in any way. Generally the lower the p value, the more significant the results are and the less likely they were caused by chance.

STUDY TIP

Statistical significance refers to the likelihood that the results of an experiment are not due to *chance*. It does *not* refer to how important the results are. Any strong definition of statistical significance must refer to chance.

Ethics in Research

Because psychological research involves humans and animals, psychologists must consider the ethical implications of the research design. Careless methods can potentially cause significant physical or psychological harm, and psychologists have developed guidelines to protect participants.

Human Participants

The United States government requires that every institution receiving federal support establish an Institutional Review Board (IRB) to evaluate and approve all research studies. Many other professional organizations, including the American Psychological Association (APA), have also created ethical guidelines for the protection of participants. Any research involving humans must receive prior approval from an IRB to ensure that participants are protected from physical and emotional harm and that all ethical guidelines are met. IRB's carefully review all proposed studies and evaluate the potential harm caused against the potential benefits that would result from a study.

Table 4.4. Ethical Guidelines for the Protection of Research Subjects

Ethical Consideration	Definition	Researcher or Participant Rights and Responsibilities
Physical or Emotional Harm	Participants cannot be exposed to severe physical or emotional harm.	• Studies involving even *minimal* physical pain or emotional distress must be approved by an IRB board. • Participants must be informed prior to the start of the experiment if any short-term stress or discomfort might occur.
Informed Consent	Participants must know that they are involved in research and participate voluntarily.	• Participants must be informed about the purpose, time commitment, and procedures of the experiment. • Participants must be told that they can withdraw from the experiment at any time (*voluntary participation—no coercion*). • Participants must be informed about the potential benefits and risks associated with the research. • Participants must be informed if they will be paid for participation.
Confidentiality	Participants' privacy must be protected.	• Researchers must disguise the identity and actions of the participants when presenting findings. • Researchers must obtain permission to record the voices of participants.
Deception	Research practice that involves misinforming participants regarding the true nature of the study.	• Researchers *cannot deceive* participants without prior approval from the IRB. • Researchers *cannot deceive* participants by providing false statements about their training. • Researchers *cannot deceive* the public by falsifying data (*falsification*). • Researchers *cannot deceive* participants by failing to warn them about potential pain or stress that may be associated with the research. • Researchers *can deceive* participants about the hypothesis if the IRB determines benefits outweigh the drawbacks. • Researchers *can deceive* participants if the IRB determines there is basic or applied research value.
Debrief	Researchers must fully explain the details of the research and inform participants if any deception was involved; this must be done immediately after the research ends.	• Participants must be told whom to contact if they have questions in the future regarding the experiment.

Nonhuman Subjects

Psychology also involves the study of nonhuman animals, and these experiments have often provided the basis for psychological theories and treatment. The controversy over animal rights occurs when animals are exposed to treatments that might be harmful to humans. The American Psychological Association (APA) has created ethical guidelines for the protection of animals in research. These guidelines include using only legally obtained animals, complying with all federal and state regulations, and providing humane housing and care procedures. Prior to the use of animals in any study, it must be demonstrated to an IRB that the research has scientific value, especially if the animals will be harmed or subjected to pain in the process. If an animal's life needs to be terminated, this must be handled in a humane manner.

DIDYOUKNOW?

One of the most infamous experiments involving a human participant, known as the "Little Albert" experiment, was conducted by behaviorist John B. Watson and his assistant Rosalie Rayner. Watson exposed nine-month old Albert to a series of objects, including a white rat, a rabbit, a monkey, various masks, and a burning newspaper. The infant showed no fear. The next time Albert was shown the white rat, Watson hit a metal pipe with a hammer. At the sound of the loud noise, the infant began to cry. Watson repeatedly showed Albert the white rat paired with the loud noise, until the infant began to cry at the sight of a white rat. Today, would this experiment fall within the ethical guidelines described in this text? Most definitely not. So did these triggers of fear plague Albert throughout his life? After a seven-year search to find the real identity of Albert, in 2010, researchers identified the baby as Douglas Merritte, who, sadly, died at the age of six of acquired hydrocephalus.

Bias in Research

Interpreting psychological research involves thinking critically about the various types of bias that can distort findings. Bias involves how either consciously or unconsciously our attitudes, behaviors, and expectations can influence research outcomes. Different types of bias can influence how researchers design and evaluate a study and how participants behave. The various types of bias important in psychological research are explained in Table 4.5.

Table 4.5. Common Types of Bias in Research Design

	Definition	Prevention Strategy	Example
Hindsight Bias	Tendency to believe we could have predicted the outcome of an event after it already happened	Awareness of this bias and the use of the scientific method	After taking the AP Psychology Exam and seeing the questions, Garrett announces that he knew all along that the free-response question would be about statistics.
Confirmation Bias	Tendency to selectively attend to information that is consistent with our viewpoint and ignore or minimize information that challenges our beliefs	Researchers seek evidence that might disprove their hypothesis. Researchers publish their results for critical evaluation by the scientific community.	Erica and Jenny both read the same article about the use of animals in experimental research. Erica believes it is inhumane to use animals in research and notices only facts that back up her beliefs. Jenny believes animal testing is valuable and notices only statements that support her claim. Both Erica and Jenny are exhibiting confirmation bias.
Overconfidence Bias	Tendency to overestimate how correct our predictions and beliefs about ideas actually are	Psychologists test their hypotheses with controlled experiments.	Students are often overconfident when editing their own papers. When they submit a paper to be proofread by their teacher, they do not expect that any mistakes will be found. After receiving the returned paper, they are surprised by how many spelling or grammar mistakes were actually made.
Experimenter Bias	Tendency for researchers to unknowingly influence the results in an experiment	Double-blind studies prevent researchers from knowing which subjects are receiving the treatment.	Clever Hans, a famous horse, was known for his amazing ability to respond to mathematical equations by tapping his hoof. Through careful observation, it was found that his owner was unintentionally cuing the horse through body language. Similarly, researchers may unknowingly provide signals that will impact participant behavior.
Social Desirability Bias	Tendency for subjects to not answer personal questions honestly in order to create/ depict themselves in a positive way	Participants can be given a social desirability assessment that will correct for this bias.	Arthur is completing a survey about his driving behavior and indicates that he never speeds and never fails to come to a complete stop at a stop sign, even though he knows this is not true. Arthur answers incorrectly because he wants to be perceived positively by others.