

Chapter 1: Scientific Understanding of Behavior

Learning Objectives

- Describe why it is essential to understand research methods.
- Explain the scientific approach to learning about behavior and be able to compare and contrast it with other ways of knowing.
- Identify and explain key features of the scientific approach to understanding behavior, and be able to compare and contrast it with a pseudoscientific approach.
- Describe and give examples of the four goals of scientific research: description, prediction, determination of cause, and explanation of behavior.
- Summarize the three elements for inferring causation: temporal order, covariation of cause and effect, and elimination of alternative explanations. Be able to generate an example.
- Determine whether a study is basic or applied research.

Brief Chapter Outline

- I. Consuming Research
 - A. Why Learn About Research Methods?
- II. Ways of Knowing
 - A. Intuition
 - B. Authority
 - C. Empiricism
 - D. The Scientific Approach
 - E. Skepticism
- III. Being a Skilled Consumer of Research
- IV. Goals of Behavioral Science
 - A. Description
 - B. Prediction
 - C. Determining Causes
 - D. Explaining Behavior
- V. Basic and Applied Research
 - A. Basic Research
 - B. Applied Research
 - C. Comparing Basic and Applied Research

Extended Chapter Outline

Please note that much of this information is quoted from the text.

I. Consuming Research

We are continuously bombarded with research results. Articles, books, websites, and social media posts make claims about the beneficial or harmful effects of particular diets or vitamins on one's sex life, personality, or health. There are frequent reports of survey results that draw conclusions about our views on a variety of topics ranging from politics to the economy, health, education, and the environment.

A. Why Learn About Research Methods?

Learning about research methods is essential for many reasons. First, many occupations require the use of research findings. It is also important to recognize that scientific research has become increasingly prominent in public policy decisions. Research is also important when developing and assessing the effectiveness of programs designed to achieve certain goals—for example, improving high school graduation rates in a community, influencing people to be vaccinated, teaching employees how to reduce the effects of stress, or making a workplace welcoming and productive for everybody. Finally, research methods can be the way to satisfy our native curiosity about ourselves, our world, and those around us.

II. Ways of Knowing

People have always observed the world around them and sought explanations for what they see and experience. So, the question must be asked: How does the scientific approach differ from other ways of learning about behavior?

A. Intuition

When people rely on intuition, they accept unquestioningly what their own personal judgment or a single story (anecdote) about one person's experience tells them. The intuitive approach takes many forms. Often it involves finding an explanation for our own behaviors or the behaviors of others. For example, you might develop an explanation for why you keep having conflicts with your roommate, such as "My roommate hates me" or "Having to share a bathroom creates conflict." Other times, intuition is used to explain events that you observe, as in the case of concluding that adoption increases the chances of conception for people who are having difficulty conceiving a child. A problem with intuition is that numerous cognitive and motivational biases affect one's perceptions, and so one may draw erroneous conclusions about cause and effect.

B. Authority

Humans are often persuaded by those in authority. Many people are all too ready to accept anything they learn from the Internet, news media, books, government officials, celebrities, religious figures, or even a professor because they believe that statements made by such authorities must be true. The problem is that the statements may not be true. The scientific approach rejects the notion that one can accept *on faith* the statements of any authority; more evidence is needed before people can draw scientific conclusions.

C. Empiricism

The fundamental characteristic of the scientific approach is empiricism—the idea that knowledge comes from observations. Data are collected and analyzed, and the data form the basis of conclusions about the nature of the world.

D. The Scientific Approach

Data Play a Central Role

For scientists, knowledge is primarily based on observations. Scientists enthusiastically search for observations that will verify or reject their ideas about the world. They develop theories, argue that existing data support their theories, and conduct research that can increase their confidence that the theories are correct.

Scientists Are Not Alone

Scientists make observations that are accurately reported to other scientists and the public. Many other scientists will follow up on the findings by conducting research that replicates and extends these observations.

Science Is Adversarial

Science is a way of thinking in which ideas do battle with other ideas in order to move ever closer to truth. Research can be conducted to test any idea; supporters of the idea and those who disagree with the idea can report their research findings, and these can be evaluated by others. Some ideas, even some very good ideas, may prove to be wrong if research fails to provide support for them. Good scientific ideas can be supported or they can be falsified by data—the latter concept is called **falsifiability**.

Scientific Evidence Is Peer Reviewed

Before a study is published in a top-quality scientific journal, other scientists who have the expertise to carefully evaluate the research review it. This process is called **peer review**.

E. Skepticism

There is nothing wrong with having opinions or beliefs as long as they are presented simply as opinions or beliefs. However, people should always ask whether the opinion can be tested scientifically or whether scientific evidence exists that relates to the opinion—in essence, to be skeptical of these claims. People should also be skeptical of pseudoscientific research.

Pseudoscience is the use of seemingly scientific terms, and demonstrations are used to substantiate claims that have no basis in scientific research.

III. Being a Skilled Consumer of Research

Sometimes study authors overreach, coming to conclusions that are not justified. Here are eight key questions you can ask of any research study that will reveal a lot about how much the study should be trusted:

1. “What is the primary goal of this study? Description, Prediction, Determining Cause, or Explaining? Do the authors achieve their goals?”
2. “What did these researchers do? What was the method?”
3. “What was measured?”
4. “To what or whom can we generalize the results?”
 - **Generalization** involves making broad or general inferences based on the procedures and findings in a specific study
5. “What did they find? What were the results?”
6. “Have other researchers found similar results?”
7. “What are the limitations of this study?”
8. “What are the ethical issues present in this study?”

IV. Goals of Behavioral Science

Scientific research on behavior has four general goals:

- description
- prediction
- determining causes
- understanding or explanation

A. Description

Description is the first goal of science. Psychologists and other behavioral scientists can describe behavior, which can often be directly observed (such as the amount of food consumed, running speed, eye gaze, or loudness of laughter), or mental states (such as happiness, sadness, or boredom), which are often less observable. Researchers are often interested in describing the ways in which events are systematically related to one another.

B. Prediction

The second goal of behavioral science is to make accurate predictions. Once events have been shown to be related to one another—for example, that early-childhood poverty is related to lower school achievement—predictions can be made.

C. Determining Causes

There are three types of evidence used to identify the cause of. In the simplest case, where a change in one variable causes a change in another, three things must hold:

- There is a temporal order of events in which the cause *precedes* the effect. This is called **temporal precedence**.
- When the cause is present, the effect occurs; when the cause is not present, the effect does not occur. This is called **covariation of cause and effect**.
- Nothing other than a causal variable could be responsible for the observed effect. This is called elimination of **alternative explanations**.

D. Explaining Behavior

The final goal of science is to explain—to understand why a behavior.

V. Basic and Applied Research

A. Basic Research

Basic research tries to answer fundamental questions about the nature of behavior. Studies are often designed to address theoretical issues concerning phenomena such as cognition, emotion, motivation, learning, personality, development, and social behavior.

B. Applied Research

Applied research is conducted to address issues in which there are practical problems and potential solutions. A major area of applied research is called **program evaluation**, which assesses the social reforms and innovations that occur in government, education, the criminal justice system, industry, health care, and mental health institutions.

C. Comparing Basic and Applied Research

Both basic and applied research are important, and neither can be considered superior to the other. In fact, progress in science is dependent on an interconnection between basic and applied research. Much applied research is guided by the theories and findings of basic research investigations.

Engaging With Research: Introduction

After reading the article, answer the following questions (which will be familiar to you from earlier in this chapter!). NOTE: Student answers will vary.

1. What is the primary goal of this study? Description, Prediction, Determining Cause, or Explanation? Do the authors achieve their goals?
 - a. Did these researchers discuss cause and effect? Did they make claims about how the things they measured cause changes in one another? Did they claim that being Latinx caused differences in gratitude?
 - b. Would you describe this study as applied research or basic research? Why?
2. What did these researchers do? What was the method?
3. What was measured?
4. To what or whom can we generalize the results?
 - a. Corona et al. (2021) collected data from a group of Latino, East Asian, and European men in their first study, and Latino and East Asian men in their second. In both cases, the research participants were from American universities. Do you think the results would be different if the researchers collected data from other populations? What about men from universities in

other countries? Or women? Or people who were not university students? Do you think their results would be different?

5. What did they find? What were the results?

6. Have other researchers found similar results?

7. What are the limitations of this study?

a. What did the authors say about the limitations of the study in the discussion section?

8. What are the ethical issues present in this study?

a. Review the methods section: What ethical issues or procedures were addressed in the study?

Sample Answers for Review Questions

1. Why is it important for anyone in our society to have knowledge of research methods?

A background in research methods will help people read research reports critically, evaluate the methods employed, and decide whether the conclusions are reasonable. Learning about research methods will help people think critically. Many occupations require the use of research findings. It is also important to recognize that scientific research has become increasingly prominent in public policy decisions. Research is also important when developing and assessing the effectiveness of programs designed to achieve certain goals. Research methods can be the way for people to satisfy their native curiosity about ourselves, our world, and those around us.

2. How does the scientific approach differ from other ways of gaining knowledge about behavior?

In the scientific approach, data are collected and shared with peers. Adversarial conclusions are drawn from the data, and those conclusions are also shared with and reviewed by peers.

3. Why is scientific skepticism useful in furthering our knowledge of behavior?

Scientific skepticism means that ideas must be evaluated on the basis of careful logic and results from scientific investigations. The fundamental characteristic of the scientific method is *empiricism*—the idea that knowledge comes from observations. Data are collected that form the basis of conclusions about the nature of the world.

4. Provide (a) definitions and (b) examples of description, prediction, determining cause, and explaining behavior as goals of scientific research.

Description of behavior is based on careful observation and can be something directly observable, such as running speed, or something less observable, such as self-perception. Researchers often try to describe the ways in which events are systematically related to one

another. Prediction of behavior involves anticipating events based on observations and descriptions, such as predicting that a physically attractive defendant in a criminal trial will receive a more lenient sentence than an unattractive defendant guilty of the same offense. Determination of cause involves correctly identifying the underlying reason for a behavior, such as determining whether the correlation between the level of a child's violent behavior and the amount of violent television programming the child has been exposed to is actually caused by exposure to violent programming or is caused by some other element. Explanation is very closely related to determining cause, and it seeks to explain reasons for observed behaviors. The previous example about violent television programming would also be applicable to explanation; however, the explanation may require modification if another cause or causes of the behavior are identified.

5. Describe the three types of evidence necessary in order to infer causation (Cook and Campbell, 1979).

The three types of evidence for inferring causation include temporal precedence, which is an order of events in which the cause precedes the effect; covariation of cause and effect, in which an effect occurs if the cause is present and does not occur if the cause is absent; and elimination of alternative explanations, in which nothing other than a causal variable can be responsible for an observed effect.

6. Describe the characteristics of scientific inquiry, according to Goodstein (2000).

Goodstein's (2000) characteristics for scientific inquiry are that data play a central role, scientists are not alone, science is adversarial, and scientific evidence is peer reviewed.

7. How does basic research differ from applied research?

Basic research differs from applied research because basic research tries to answer fundamental questions about the nature of behavior, and applied research tries to address issues in which there are practical problems and potential solutions.

Sample Answers for Being a Skilled Consumer of Research

1. Imagine a debate on the following statement: “Knowledge of research methods is unnecessary for students who intend to pursue careers in clinical and counseling psychology.” Develop “pro” and “con” arguments—arguments that support or oppose the assertion.

Students’ answers will vary.

2. Read several editorials in your college’s newspaper or in *The New York Times*, the *Wall Street Journal*, *USA Today*, the *Washington Post*, or another major metropolitan news publication, and identify the sources used to support the assertions and conclusions. Did the writer use intuition, appeals to authority, scientific evidence, or a combination of these? Give specific examples.

Students’ answers will vary based on the examples they choose.

3. Imagine a debate on the following statement: “Behavioral scientists should only conduct research that has immediate practical applications.” Develop “pro” and “con” arguments—arguments that support or oppose the assertion.

Students’ answers will vary.

4. You read a social media post that says, “Childhood poverty has a stronger impact on academic achievement among Black children as compared to White children.” The study itself collected data from a sample of White children in the Northwest, and Black children in Texas. How strongly should researchers make a case for effect? Why?

Students’ answers will vary.

Laboratory Demonstration: The False Consensus Effect

People often believe that others are more like them than they really are. Thus, one’s predictions about others’ beliefs or behaviors, based on casual observation, are very likely to err in the direction of one’s own beliefs or behavior. For example, college students who preferred brown bread estimated that over 50% of all other college students preferred brown bread, while white-bread eaters estimated more accurately that 37% showed brown bread preference (Ross et al., 1977). This is known as the false consensus effect (Mullen et al., 1985; Ross et al., 1977). The false consensus effect provides the basis for the following demonstration, which emphasizes the need for systematic rather than casual observation.

Before describing the false consensus effect, have students answer the questions listed below. Next, have students predict the *class mean* for each question. Collect the data sheets. According to the false consensus effect, students' predictions about the class mean should be influenced by their own positions. Consequently, a student whose position is below the class mean is likely to make a prediction that will be below the class mean as well.

To demonstrate the effect statistically, compute the class mean for each question using the students' personal data. To involve the students in this process, divide the class into six groups and assign one question to each. Have them tabulate the answers for that question and calculate the mean. (Be sure each group has access to all the data sheets—rotating six batches of data sheets from one group to another until all groups have recorded data from all batches.) Put the means on the board. Next, have students compute a score for each participant in the following way: For each question, score $a + 1$ if the participant's personal answer and predicted class mean are either both below or both above the actual class mean; score $a - 1$ if the participant's personal score and predicted class mean are on opposite sides of the actual class mean. Sum all six questions so that each participant now has a single score that ranges between -6 and $+6$. If people err randomly, the average score for all students should be zero. In contrast, if people err in the direction of their own beliefs, the average should be greater than zero. A simple, one-group t test can be calculated using $m = 0$ for the null hypothesis.

Behavior Questions

Personal prediction answer for class

1. How many loads of laundry do you wash per week?
2. How many times per year do you attend services at a place of worship?
3. How many times per week do you eat a meal from a fast-food restaurant?
4. How many times per year do you wash your car?
5. How many times per year do you see a movie at a theater?
6. How many times per week do you consume alcohol?

Mullen, B., Atkins, J. L., Champion, D. S., Edwards, C., Hardy, D., Story, J. E., & Vanderlok, M. (1985). The false consensus effect: A meta-analysis of 115 hypothesis tests. *Journal of Experimental Social Psychology*, 21, 262–283.

Ross, L., Greene, D., & House, P. (1977). The false consensus phenomenon: An attributional bias in self-perception and social perception processes. *Journal of Experimental Social Psychology*, 13, 279–301.

Laboratory Demonstration: Single Versus Multiple Observations

The systematic observation employed by scientists generally relies on many independent instances, while casual observation is often based on only a few instances. The following demonstration is designed to show how misleading a small sample of observations may be. Divide the class into groups of three or four students each. Fill a bowl or basket with a “population” of poker chips or simple slips of paper. On each chip or piece of paper there should be written a single score. (An approximate normal distribution of 200 numbers is provided below.) Have each group draw five samples from the population and compute the mean for each sample. Each group, however, should draw samples of a different size from the other groups. For instance, group one draws five samples of Size 1, group two draws five samples of Size 3, group three draws five samples of Size 5, and so on. The rate of progression from small to large samples depends on the number of groups. It is a good idea to have the last group draw fairly large size samples (e.g., $N = 20$ or 25). Once the means for each sample are computed, have each group plot the means on a graph on the board. It should be obvious that with small samples we can easily get a distorted picture of the population mean. Note how the variability from sample mean to sample mean decreases dramatically as we increase the sample size. Discuss how many of our casual observations are based on relatively few observations.

The following population of scores yields a population mean of 17 and a standard deviation of 4.66.

X	f	X	f
5	1	23	7
6	2	24	5
7	2	25	4
8	3	26	3
9	4	27	2
10	5	28	2
11	7	29	1
12	9	200	
13	10		
14	13		
15	16		
16	18		
17	10		
18	13		
19	16		
20	13		
21	10		
22	9		

Note: This population of scores can be used for demonstrations suggested in Chapters 8 and 12.

Activity: Observing Behavior

It is often useful to have students immediately begin making observations of behaviors. In class, students might generate a list of possible behaviors to observe on campus. For example, observe the age, ethnicity, and dress of students in various campus locations, such as different eating/gathering places, the library, and the computer center. How many students are alone, in groups of two, or groups of three or more; are these same- or mixed-gender groups? Check door cards on faculty offices to see whether the occupant is an assistant, an associate, or a full professor, and note whether the office has a window. Categorize restroom graffiti; how much is aggressive, sexual, humorous, or political? A discussion based on these observations in class can introduce students to many topics and procedures of research methods.

Activity: Setting up a Research News Group

Research-related stories often appear on a variety of web-related sources. A news group may be set up containing research-related stories from the American Psychological Association and American Psychological Society Press releases, and regional psychological association press releases. Students could sign up for the newsgroup and receive emails with stories relevant to topics dealing with *research methods*.

Additional Discussion Topics

Discussion: The Gambler's Fallacy

Another way to illustrate the limitations of intuition is to discuss the gambler's fallacy. Ask students the following: If they were in Vegas and they pulled a slot machine arm 25 times with no payout, would there be a greater probability that the next pull would pay out? Or if one flips a coin 20 times and gets heads each time, is one more likely to get tails on the next trial? Even though students may understand probability intellectually, a part of their brain says, "Yes, it is more likely!" That would imply that each trial is not independent, but rather it is dependent on prior trials.

Discussion: Operational Definitions

Most students have not discussed operational definitions since Introduction to Psychology. Explain that research hinges on an operational definition that specifically includes AND excludes things from the definition. For example, ask students to define aggression. One can expect the usual examples of hitting, pushing, punching, kicking, and so on; now ask about indirect forms, such as spreading rumors, keying someone's car, and so on. Now what about sports? Are hockey players aggressive? What about football? What about consensual sex between adults that involves harm to one of the participants? Remind students that the role of definitions is to both include things, such as hitting and spreading rumors, while excluding other things, such as sports and other consensual adult behaviors.

Suggested Readings

Articles in the Handbook for Teaching Statistics and Research Methods (2nd ed.)

Brems, C. (1994). Taking the fear out of research: A gentle approach to teaching an appreciation for research. *Teaching of Psychology* 21, 241–243.

Johnson, D. E. (1996). A "handy" way to introduce research methods. *Teaching of Psychology*, 23, 168–170.

Also recommended:

Lakin, J. L., Giesler, R. B., Morris, K. A., & Vosmik, J. R. (2007). HOMER as an acronym for the scientific method. *Teaching of Psychology*, 34, 94–96.

Marek, P., Christopher, A. N., & Walker, B. J. (2004). Learning by doing: Research methods with a theme. *Teaching of Psychology*, 31, 128–131.