

Chapter 1 – What is Science?

Chapter Outline

Science as a Way of Knowing

Tenacity

Authority

Reason

Common Sense

Science

Pseudoscience and Superstition

The Scientific Approach

Early Approaches

Overview

Studying Behavior and Experience

Behavior: A Road Into the Subjective Experience of Research Participants

The People Who Perform Science

Chapter Overview

Knowledge about the world is gathered in several ways. In tenacity, a belief is accepted because it is presented over and over again. Authority is a way of knowing in which we accept an idea because an authority figure tells us to. Knowledge can be acquired through reason and logic. Direct experience serves as the basis of common sense, which can lead to knowledge. Each possesses shortcomings.

In contrast to these three, science relies upon the scientific method that allows for self-correction of ideas. The examples of Croesus, Galen, and Semmelweis provide historical insight in the development of science. Science verifies itself because of its empirical nature whether one is studying at the cognitive, physiological, or behavioral level. In investigating the subjective experience of subjects, science must rely upon making inferences from what is directly observable and objective. Above all, science is a human activity conducted by people and communicated to people.

Chapter Objectives

1. What roles do the scientist, research participant, and witness play in science?
2. Compare and contrast between the different methods of knowing: tenacity, authority, reason, common sense, and science.
3. How did Galileo advance our thinking from authority to empiricism?
4. What is pseudoscience and why does it often influence people's beliefs?
5. What important strides did Croesus, Galen, and Semmelweis make? How have we advanced in our contemporary scientific approach?

6. What are the major characteristics of the scientific approach?
7. Why are scientific conclusions never considered final?
8. What is the importance of replication in science? How is replication part of the feedback component in science?
9. Explain how the scientific method's feedback component refines ideas.
10. What are Newton's Rules of Reasoning (1680) and how are they still utilized today by scientists?
11. How does the concept of empiricism relate to our study of behavior and experience?
12. Summarize Schumacher's four ways of studying psychological processes.
13. How is psychology like other sciences in its reliance on objective observation to study indirectly unobservable phenomena?

Teaching Points

Often students do not appreciate the self-corrective mechanism of science. You may wish to stress this by showing how theories undergo modification when the data warrant. Point out that some laypeople see this as a weakness of a theory and science, thinking, “if it changed, it must not have been a very good theory.”

Sometimes students are confused when studies of a psychological phenomenon yield conflicting results. One possible reason for this is that the level of analysis may differ between studies. You may wish to incorporate this in the discussion of empiricism.

Students sometimes jump to the conclusion that all the ways of knowing things that are addressed in the textbook (tenacity, authority, reason, and common sense) have little value compared to the scientific method. A discussion of how authority, reason, and common sense are often good might be helpful. At the same time, the value of the scientific method as a powerful investigative tool to test ideas should be stressed.

To emphasize the empirical/theoretical distinction, use concrete examples such as

- Is a person who is withdrawn and keeps away from the crowd shy or a snob?
- Is a rat that is displaying aggressive behavior experiencing anger, displeasure, or sexual arousal?
- Is someone who is crying sad or happy?
- Is a person who is getting good grades motivated by success or motivated by a fear of failure?

It is critical that students understand that inferences must be made of internal, subjective processes. Inferences, however, are not foolproof. To illustrate this, lead a discussion of

the inferences that students make of others based on appearance, race, or gender that are ultimately found to be incorrect.

Teaching Activities

Background Knowledge Probe

To introduce students to the concepts and principles of this textbook and to help you gain a sense of what they bring to the course, consider assessing their background. Use Handout 1-1 before starting the course and think of repeating it at the end of the course to measure how much students have learned.

What is Science?

To introduce this chapter, consider asking students to share their views of what science is and what scientists do. Contrast these perceptions with their sense of what psychology is and what psychologists do. You can accomplish this by asking them to write or to say the first thing that comes to mind. Often students do not see psychology as a science, but simply and entirely as a mental health profession.

Pseudoscience and Superstition

Ask students to recall any advertisements they have encountered that have used pseudoscience as a means to persuade potential customers that a product really works. Next, ask students to describe some common superstitions (e.g., walking under a ladder is bad luck) and to surmise how such false beliefs got started.

Logging Ways of Knowing

We probably have experience with each of the ways of knowing presented in Chapter 1. Ask students to keep a log or journal of how they use each of the ways of knowing in their daily activities (e.g., working, studying, interacting with others).

Comparisons of Ways of Knowing

Using Handout 1-2, ask students to identify the characteristics of tenacity, authority, reason, common sense, and science. Next, students should form groups and review their responses.

Decision Making

Ask students to brainstorm how they would use tenacity, authority, reason, common sense, and science to make decisions. Possible decisions include purchasing a particular used car or selecting a graduate school.

The Use of Reasoning in Science

As the textbook suggests, science involves the process of reasoning. To emphasize this point, use the question of whether animals can see color. Make sure the students understand the different conclusions that follow depending on whether the color choices for the animal are blue/green, color/no color, or blue/green/no color. Discuss how this experiment could be adapted to test whether babies can see color. Suggest to students that subjective experience can be answered only through inference from behavior.

Wadsworth's Research Methods Workshop

http://www.wadsworth.com/psychology_d/templates/student_resources/workshops/resch_wrk.html

The Wadsworth's Research Methods Workshop site has a link labeled *What is Science?* that includes relevant information pertaining to the scientific method. This workshop segment gives students a chance to compare their personal definition of science to a textbook definition. A contrast also is provided between the characteristics of science to other methods for fixing beliefs.

Internet Resources

Statistical Assessment Service (www.stats.org)

The purpose of this website is to provide comment on the accuracy of scientific and social research. It attempts to identify "bad data and research." Of particular interest are the Dubious Data Awards, which highlight the worst cases of "bad research."

Philosophy of Science (www.philosopher.org.uk/sci.htm)

You will find information on most of the philosophies and philosophers that have shaped the sciences, such as John Locke.

4000 Years of Women in Science (<http://www.astr.ua.edu/4000WS/>)

This site describes the contributions of women in science from the past 4000 years. It includes biographies of many scientists.

Randi \$1,000,000 paranormal challenge (<http://skepdic.com/randi.html>)

Here is a chance to win a \$1,000,000 prize. However, it will not be easy and this site tells us why. The fact that no one has yet claimed the prize warns us that we should all be skeptical of paranormal, supernatural, and pseudoscientific claims.

Classics in the History of Psychology (<http://psychclassics.yorku.ca>)

A wealth of information from primary sources on the history of psychology is found here. Relevant examples include statistics and the role of women in psychology.

Research Activities for Students

The goals of the research activities are to: (1) relate Chapter 1 on an applied learning dimension, and (2) get students involved in research.

1. Insanity Plea: Inferring Subjective Experience in Science.

As discussed in the text, scientists often use objective behavior to study subjective experience. Use online references such as PsycINFO and PubMed to find a research article in a psychology journal on the subject of the insanity plea. Address the following below:

- a. Cite the author(s), the year published, the name of the article, the journal, and the page numbers.
- b. What were the research questions?
- c. How did the author use observable behavior to infer insanity? How was insanity measured?
- d. Do you think this was a valid way to measure insanity? If so, what convinced you that it is a valid measure? If not, what would convince you that it was a valid measure?
- e. What conclusions do the investigators reach in this article? How are they tentative or probabilistic? Did the investigators claim they "proved" anything?

2. *Science in the Media. Science is all around us.*

Use online references such as PsycINFO and PubMed to find a study that uses the scientific method. Identify the research question, how the information was acquired, and what was concluded. Be prepared to report on your research in class and explain what you recognized as the important features of the scientific method.

3. *Who is Smarter, Girls or Boys?*

Ask five people these questions: 1) Who is smarter, girls or boys? 2) Why do you think so? Record each statement that is based on tenacity.

- a. Record the statement.
- b. Explain if it is widely accepted.
- c. Discuss in what ways this belief is perpetuated by individuals, the media, or other means.
- d. How would science address this question?

4. *Ted Bundy. Porn Addict and Serial Killer: Questioning Claims of Authority.*

Go to the library and find this article:

Ellis-Simons, P. (1989). New hero of a new right: The rising voice of a family crusader. *U.S. News & World Report*, 106 (5), 27.

This popular psychologist interviewed serial killer Ted Bundy before his execution. He attributed Bundy's motivation to kill to his addiction to pornography. Do you agree or disagree with the conclusions of this authority? What other articles can you find on this topic?

5. *Theories.*

Use online references such as PsycINFO and PubMed to identify a psychological theory. Who developed the theory? Explain the theory. What does it predict?

6. *Women in Science.*

Use the Internet to find information about women in science over the past 4000 years.
(www.astr.ua.edu/4000WS/summary.shtml)

Handout 1-1
Background Knowledge Probe

As you read each term, assess how much you know about it by using the following scale:

- 1--- I have heard of this term
- 2--- I have heard of this term, but I can't really say what it means
- 3--- I have heard of this term and I have a general idea of what it means
- 4--- I have heard of this term and I could explain its meaning to someone

empiricism	1	2	3	4
scientific method	1	2	3	4
marker variable	1	2	3	4
experimental method	1	2	3	4
hypothesis	1	2	3	4
confounding variable	1	2	3	4
external validity	1	2	3	4
modus ponens	1	2	3	4
nominal measurement	1	2	3	4
z score	1	2	3	4
standard deviation	1	2	3	4
degrees of freedom	1	2	3	4
null hypothesis	1	2	3	4
F-ratio	1	2	3	4
alpha level	1	2	3	4
Type I error	1	2	3	4
counterbalancing	1	2	3	4
factorial design	1	2	3	4
main effects	1	2	3	4
matched-subjects design	1	2	3	4
Hawthorne effect	1	2	3	4
placebo factors	1	2	3	4
time series design	1	2	3	4
naturalistic case study	1	2	3	4
probability sampling	1	2	3	4
reactive questions	1	2	3	4
snowball sampling	1	2	3	4
informed consent	1	2	3	4
debriefing	1	2	3	4
deception in research	1	2	3	4
institutional review board	1	2	3	4
multiple working hypotheses	1	2	3	4

Handout 1-2
Comparisons of Ways of Knowing

Way of Knowing	Description	Advantages	Disadvantages
tenacity			
authority			
reason			
common sense			
science			

TESTBANK

MULTIPLE CHOICE

1. A scientist and a child are alike in that both:
- experience the state of synesthesia as reality is discovered.
 - learn to understand the world by relying on authority.
 - follow logical principles to test hypotheses.
 - learn to understand the world through experience.

ANS: D PTS: 1 REF: Introduction MSC: WWW

2. If a child learned that a stove was hot by touching it, then her knowledge was gained through:
- induction.
 - deduction.
 - experience.
 - inference.

ANS: C PTS: 1 REF: Introduction

3. Science is based on the notion that to discover the world, one must:
- develop ideas of how the world operates.
 - experience it.
 - reason how the world ought to be.
 - discover through philosophy the functions of the world.

ANS: B PTS: 1 REF: Introduction MSC: WWW

4. Frank and Steve are coworkers. Frank has an idea that he says will increase profits for the company. Steve disagrees and says, "We can't do that. We've always done it another way." This *best* illustrates _____ as a way of knowing.
- inference
 - wisdom
 - common sense
 - tenacity

ANS: D PTS: 1 REF: Science as a Way of Knowing

5. Statements that are accepted as fact just because they are frequently repeated are said to be acquired through:
- science.
 - tenacity.
 - deduction.
 - empiricism.

ANS: B PTS: 1 REF: Science as a Way of Knowing

6. One weakness of tenacity as a way of knowing is that:
- the syllogisms it produces may be illogical.
 - it requires one to experience the world.
 - sensory experiences may be misleading.
 - it has no way of correcting erroneous ideas.

ANS: D PTS: 1 REF: Science as a Way of Knowing

7. You are watching a TV talk show. On the show, you listen to the world's leading researcher on relationships and learn something that might improve your relationships. Your new knowledge was acquired through:
- authority.
 - common sense.
 - tenacity.
 - reason.

ANS: A PTS: 1 REF: Science as a Way of Knowing

8. Two students in Mrs. Anderson's first grade class are doing a class project. One of the students says, "You're not supposed to do it that way. Mrs. Anderson says you can't." The student is appealing to ____ as the way of knowing.
- rationalization
 - common sense
 - authority
 - tenacity

ANS: C PTS: 1 REF: Science as a Way of Knowing

9. Based on Chapter 1, questioning authority can serve to:
- expose how empiricism can be misused.
 - incite disrespect of people who obviously are knowledgeable.
 - cause people to question your reasoning ability.
 - examine the basis of claims by the authority.

ANS: D PTS: 1 REF: Science as a Way of Knowing

10. Galileo challenged ____ as a way of knowing by conducting experimentation.
- empiricism
 - authority
 - parsimony
 - blindsight

ANS: B PTS: 1 REF: Box 1.1

11. We can gain new knowledge through reason and logic, but the accuracy of our conclusions is dependent upon:
- the laws of probability.
 - our own experiences.
 - the accuracy of our assumptions.
 - parsimony.

ANS: C PTS: 1 REF: Science as a Way of Knowing
MSC: WWW

12. In contrast to tenacity, authority, and reason, common sense is an improvement because it:
- automatically checks our assumptions.
 - appeals to direct experience.
 - represents the accumulation of scientific knowledge.
 - is based on blindsight.
- ANS: B PTS: 1 REF: Science as a Way of Knowing
13. Juan is excited to tell Andrea that a stranger just gave him \$1,000 with no strings attached. Andrea looks at Juan and thinks that he is lying. She says, "I've never heard of that before and I've never seen that before!" This best illustrates:
- common sense.
 - tenacity.
 - authority.
 - a construct.
- ANS: A PTS: 1 REF: Science as a Way of Knowing
14. You read a study in a journal. You know that the results of the study can be verified. This is because in science, observations can be:
- self-correcting.
 - verified by anyone.
 - theoretically interpreted.
 - reviewed through tenacity.
- ANS: B PTS: 1 REF: Science as a Way of Knowing
15. ____ has a self-corrective mechanism.
- Tenacity
 - Authority
 - Science
 - Reason
- ANS: C PTS: 1 REF: Science as a Way of Knowing
16. To ensure that an experimental finding is not just a fluke, a scientist should:
- base conclusions on personal experience.
 - use logical inference.
 - operationalize the experiment.
 - replicate the experiment.
- ANS: D PTS: 1 REF: Science as a Way of Knowing
17. Many people have heard (and believe) that "you cannot teach an old dog new tricks." This statement is based on ____.
- authority
 - tenacity
 - common sense
 - science
- ANS: B PTS: 1 REF: Science as a Way of Knowing
MSC: WWW

18. Modern science began with rules of reasoning developed by:
- a. Albert Einstein.
 - b. Sir Isaac Newton.
 - c. Charles Peirce.
 - d. Ignaz Semmelweis.

ANS: B PTS: 1 REF: Box 1.2

19. Consider this: The same stages of language development are observed in children throughout the world. What would be Newton's reaction to this observation?
- a. Newton would challenge the observation since it is actually chaotic and unpredictable.
 - b. He would question the observation since it cannot be falsified.
 - c. He would not be surprised since he theorized that language development was entirely genetic.
 - d. He would see it as evidence of the natural order.

ANS: D PTS: 1 REF: Box 1.2

20. Newton's rule for developing explanations that are true, sufficient, and simple best illustrates:
- a. the law of parsimony.
 - b. empiricism.
 - c. order in nature.
 - d. tenacity.

ANS: A PTS: 1 REF: Box 1.2

21. Pseudoscientific claims are typically not:
- a. read by a large number of people.
 - b. testable.
 - c. published in peer-reviewed journals.
 - d. the subject of advertisements.

ANS: C PTS: 1 REF: Science as a Way of Knowing

22. A famous athlete appears on a television infomercial and claims that a new device to alleviate aches and pains has been extremely effective for her. Because no published, peer-reviewed studies have supported the effectiveness of the device, this may be an example of:
- a. superstition
 - b. empiricism
 - c. science
 - d. pseudoscience

ANS: D PTS: 1 REF: Science as a Way of Knowing
MSC: WWW

23. Much to his credit, the story of King Croesus illustrates the importance of:
- a. calculating probability in determining truth.
 - b. carefully defining variables.
 - c. considering multiple causes of a phenomenon.
 - d. testing in determining truth.

ANS: D PTS: 1 REF: Early Approaches

24. In his study of insomnia, Galen used:

- a. a control group.
- b. a double-blind procedure.
- c. a single-case experiment.
- d. randomization.

ANS: C

PTS: 1

REF: Early Approaches

25. The case of Semmelweis is important because it illustrates:

- a. the importance of ruling out factors.
- b. a longitudinal design.
- c. the necessity of debriefing.
- d. how bias can influence the outcome of a study.

ANS: A

PTS: 1

REF: Early Approaches

MSC: WWW

26. Because self-report and observed behaviors may not match, researchers are advised to use:

- a. sophisticated statistical measures.
- b. multiple measures.
- c. quasi-experimentation.
- d. valid surveys and questionnaires.

ANS: B

PTS: 1

REF: Early Approaches

27. The stories of Croesus, Galen, and Semmelweis are important because they reflect:

- a. how statistical analyses are conducted.
- b. the importance of random sampling.
- c. different ways of solving problems.
- d. empiricism at different levels of observation.

ANS: C

PTS: 1

REF: Early Approaches

28. Science is:

- a. experimental rather than logical.
- b. empirical rather than theoretical.
- c. not based on direct experience.
- d. based on experience and reason.

ANS: D

PTS: 1

REF: Studying Behavior and Experience

29. "I need to verify this idea through my own senses." This comment best exemplifies:

- a. empiricism.
- b. reason.
- c. tenacity.
- d. the law of parsimony.

ANS: A

PTS: 1

REF: Studying Behavior and Experience

30. To rely on sensory experience to verify ideas is called:

- a. rationalism.
- b. empiricism.
- c. modus ponens.
- d. the law of parsimony.

ANS: B

PTS: 1

REF: Studying Behavior and Experience

MSC: WWW

31. In studying reality, the philosopher relies on reason and logic, but the scientist relies on:

- a. common sense.
- b. authority.
- c. empiricism.
- d. marker variables.

ANS: C

PTS: 1

REF: Studying Behavior and Experience

32. Which of the following is not an appropriate question to ask of science?

- a. What method of reading is best to teach to first graders?
- b. Why do some people commit suicide?
- c. What is the meaning of life?
- d. How does the brain process visual information?

ANS: C

PTS: 1

REF: Studying Behavior and Experience

33. The two worlds of study in psychology are:

- a. cognitive and physiological.
- b. behavior and emotion.
- c. cognitive and experience.
- d. behavior and experience.

ANS: D

PTS: 1

REF: Studying Behavior and Experience

34. Which of the following is not one of the four possible ways of studying psychological processes, according to Schumacher?

- a. studying our own personal world
- b. studying the personal world of others
- c. studying our outward behavior that others can observe
- d. studying our spirit

ANS: D

PTS: 1

REF: Studying Behavior and Experience

35. It is sometimes possible to study processes that occur below the level of conscious awareness by using a:

- a. marker variable.
- b. construct.
- c. theory.
- d. generalization.

ANS: A

PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

MSC: WWW

36. Your score on this exam would be considered a(n):

- a. modus tollens.
- b. marker variable.
- c. independent variable.
- d. confounding variable.

ANS: B PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

37. REM would be considered to be a:

- a. construct.
- b. product of synesthesia.
- c. marker variable.
- d. theory.

ANS: C PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

38. Which of the following is not a subjective experience?

- a. shaking because of nervousness
- b. confusion
- c. severe anger
- d. sadness

ANS: A PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

39. Dr. Simon is discussing the role of inference in research. She says that psychologists study the outside to know about the inside. Is she correct?

- a. No – she has it backwards; we study the inside to know about the outside.
- b. No – inference does not play a role in research.
- c. Yes – we infer subjective experience (inside) from behavior (outside).
- d. Yes – but we don't need inference since we can directly observe subjective experience in research participants.

ANS: C PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

40. Psychologists seek to understand subjective experience through:

- a. replication.
- b. inference from behavior.
- c. common sense.
- d. direct observation.

ANS: B PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

MSC: WWW

41. Which of the following is *not* a measurable behavior?

- a. respiration rate
- b. daydreaming
- c. number of items recalled from a memorized list
- d. time taken to run 100 meters

ANS: B PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

42. In studying subjective experience, we assume that:

- a. subjective experience is a marker variable.
- b. subjective experience is directly observable.
- c. behavior and subjective experience are unrelated.
- d. behavior is a manifestation of what the subject is experiencing.

ANS: D PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

43. Subjective experiences, the origin of the universe, and subatomic physics are all examples of phenomena that:

- a. cannot be directly measured.
- b. cannot be studied scientifically.
- c. are impossible to study using inferences.
- d. are based on superstition.

ANS: A PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

44. You are studying anxiety. Which of the following can you not directly observe?

- a. heart rate
- b. nervousness
- c. sweaty palms
- d. self-report of anxiety

ANS: B PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

45. Compared to researchers in other sciences, psychologists have consisted of a:

- a. larger percentage of women.
- b. smaller percentage of women.
- c. larger percentage of minorities.
- d. larger percentage of minorities.

ANS: A PTS: 1

REF: The People Who Perform Science

MSC: WWW

46. An advantage of science as a human activity is that:

- a. science is subject to experimenter values.
- b. we can rely more on our collective common sense than on observation.
- c. science can be done within a community of other scientists.
- d. knowledge can only exist in social contexts.

ANS: C PTS: 1

REF: The People Who Perform Science

SHORT ANSWER

1. Contrast tenacity, authority, reason, common sense, and science as approaches to knowing.

ANS:

Answer not provided.

PTS: 1 REF: Science as a Way of Knowing

2. Why is pseudoscience often called "false" science?

ANS:

Answer not provided.

PTS: 1 REF: Science as a Way of Knowing

3. What are superstitions based on and how do they manage to persist despite a lack of scientific support?

ANS:

Answer not provided.

PTS: 1 REF: Science as a Way of Knowing

4. Describe how Newton's rules of reasoning question the usefulness of tenacity, reason, and common sense as ways of knowing.

ANS:

Answer not provided.

PTS: 1 REF: Box 1.2

5. Briefly describe in your own words Newton's rule of reasoning.

ANS:

Answer not provided.

PTS: 1 REF: Box 1.2

6. What insights about science do we gain from the stories of Croesus, Galen, and Semmelweis?

ANS:

Answer not provided.

PTS: 1 REF: Early Approaches

7. Define empiricism. How does empiricism give the scientist an advantage over authority and tenacity?

ANS:

Answer not provided.

PTS: 1

REF: Studying Behavior and Experience

8. Describe each of the cells of Schumacher's model of the ways to study psychological processes.

ANS:

Answer not provided.

PTS: 1

REF: Studying Behavior and Experience

9. How do scientists study what they cannot see?

ANS:

Answer not provided.

PTS: 1

REF: The People Who Perform Science

10. Describe how a psychologist might study synesthesia.

ANS:

Answer not provided.

PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

11. What is a marker variable? How would a marker variable be used to study subjective experiences?

ANS:

Answer not provided.

PTS: 1

REF: Behavior: A Road Into the Subjective Experience of Research Participants

12. Defend the assumption that science is a human activity. What implications does this assumption have on who conducts science?

ANS:

Answer not provided.

PTS: 1

REF: The People Who Perform Science