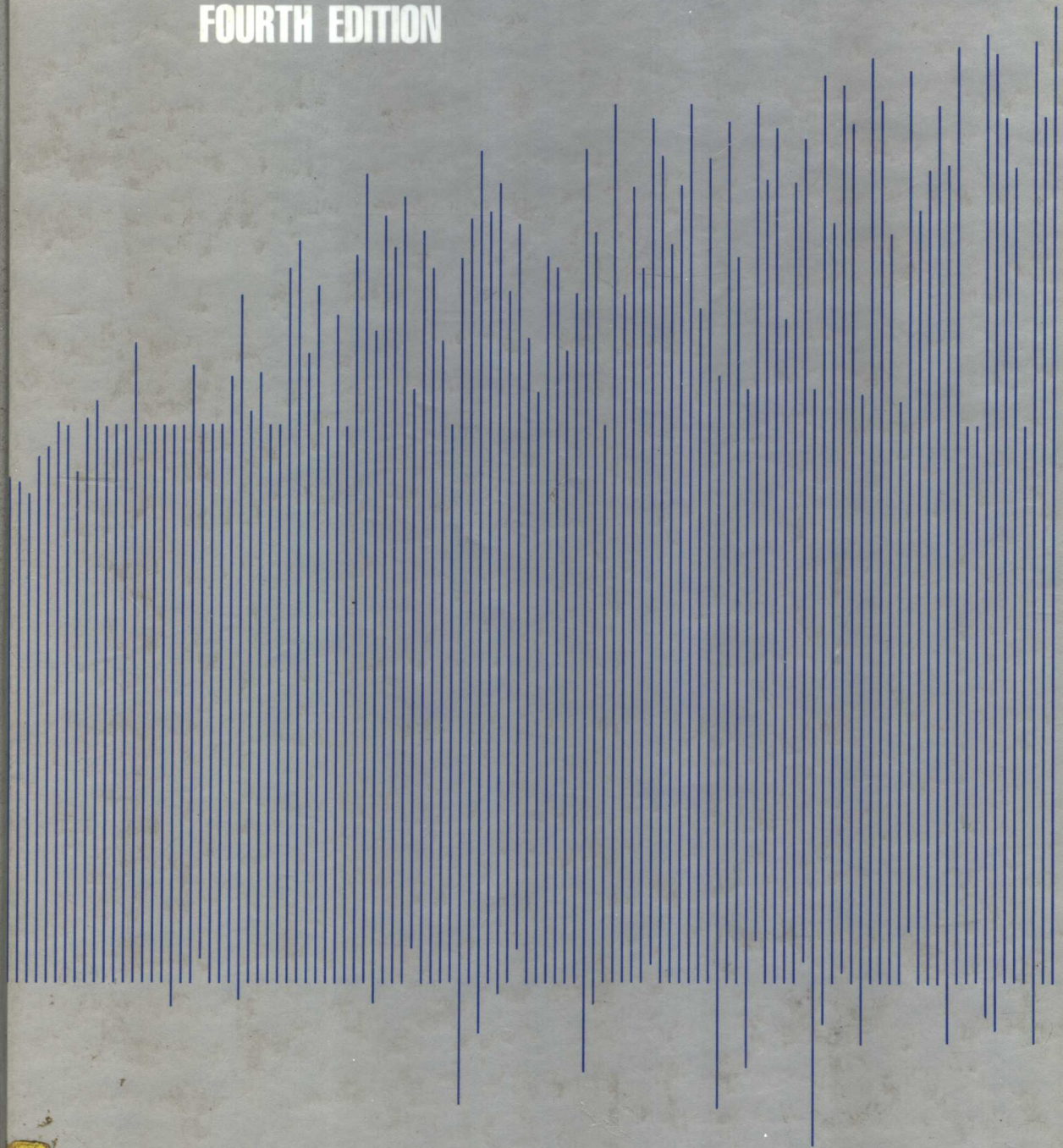


LARRY B. CHRISTENSEN

Experimental Methodology

FOURTH EDITION





Experimental Methodology

Fourth Edition

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Preface

I was pleased to begin the fourth edition of *Experimental Methodology*. Many users and reviewers have helped to make it one of the most successful methods books available, but I welcomed the opportunity to improve it. Users of the third edition recommended leaving much of the book untouched, but these same reviewers provided many helpful suggestions for improving the text. Furthermore, some changes were made in order to keep the text current.

I have tried to make this edition more student oriented. Each chapter is introduced with an opening vignette, designed to capture interest and make the material more attractive to students. Through the vignettes, the reader is exposed to an application of the methods before actually learning these methods. In addition, study questions have been added at the end of each chapter. In my experience, many students have ineffective study habits and engage in passive learning by merely reading the text. The study questions should give students active feedback to check their comprehension.

In order to make the text more pedagogically effective, I have made some changes in the actual organization. Learning objectives have been added at the beginning of each chapter to assist students in recognizing key concepts within the chapters. Chapter 2 has been split into two chapters, one focusing on descriptive research techniques and the other focusing on the experimental approach. This split seemed warranted because these two approaches are so distinct. Furthermore, the descriptive chapter has been written in such a way that instructors who cover the descriptive techniques in a separate course can drop the chapter without disrupting the continuity of the text. For those instructors who do cover these techniques in the same course, the techniques have been covered in more depth.

In order to make the text more current, the following changes were made: I incorporated a section on the role of theory in science, added a section on meta analysis (including several additional descriptive research approaches), and added the APA guidelines for the care and use of animals in research. Finally, a section on the use of computers in research methods has been added.

Once again, I am extremely indebted to the many people who have helped me complete this fourth edition. I want to thank the reviewers for their thoughtful suggestions: Michael Perone, West Virginia University; Lambert Deckers, Ball State University; George Hampton, University of Houston; Robert Abbott, University of Washington; Paul Wellman, Texas A & M University; Elvis C. Jones, Frostburg State College; and Robert Kapche, California State University at Long Beach.



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1

What Is Science?

LEARNING OBJECTIVES

1. To gain an understanding of the nature of the scientific method.
2. To understand how the scientific method differs from other methods of acquiring information.
3. To learn the unique characteristics of the scientific method and understand why each of these characteristics is necessary.
4. To understand the sort of characteristics that typify the person who is adept at pursuing the scientific enterprise.

On May 9, 1982, the Los Angeles Times ran an article in its Sunday Supplement under the headline "The Devil Made Me Do It." According to this article, some religious groups were claiming that several rock bands and recording companies were putting satanic messages on their records. The religious groups claimed that these messages could be heard only when the records were played backwards, but that the listener could subconsciously decipher the meaning of the messages when the record was played in the normal manner. Further, these groups asserted, listeners would accept the satanic message uncritically and would act accordingly.

Readers of this article probably wondered whether this was true, and whether they had been listening to satanic messages and believing them. The article also stated that these messages occasionally praised the devil and that several states had introduced legislation to require certain records to carry a label stating that they contained a satanic message. This seemed to give the assertion some legitimacy—surely legislators would not introduce a bill unless the claim had some truth to it.

The question is whether or not this accusation is true. Did several rock bands, in conjunction with their recording companies, introduce satanic messages on the records, or are the religious groups making a false accusation? In interviews, the recording companies and the bands flatly denied any such attempt. Their accusers, however, insisted that they had heard the messages. Thus, the information obtained from the religious groups and from the bands and recording companies is contradictory. Is it possible for both sides to be correct? Is it possible that no satanic messages were presented on the records, but that members of the religious groups heard such messages? The persons who stated that they had heard the satanic messages were most likely sincere individuals who actually believed that they had heard the messages. If anyone tried to deny that such messages actually existed on the records, these individuals would probably strongly oppose any such suggestion. After all, they had heard the messages, and this would seem to make their claim irrefutable.

But direct experience is only one of the many ways in which we gain information. In fact, psychological research has shown that people are likely to accept and even to experience suggestions made by others with prestige or authority if the situation is unfamiliar or vague. This seems to be exactly what happened in this instance. Very few people ever play records

backwards; if they do, the sounds they hear are unfamiliar and unclear. This is an ideal situation for suggestion to operate, particularly since the suggestion was coming from esteemed religious leaders.

In order to determine most accurately whether suggestion could have led to the perception of hearing satanic messages, we must conduct a scientific study. Few people, however, understand the nature of a scientific investigation or the need to conduct such an investigation in a situation like this. Scientists are usually conceptualized as people in white coats who work in a laboratory, conducting experiments on complex theories that are far beyond the comprehension of the average individual. The actual process or method by which scientists uncover the mysteries of the universe totally elude most people. It is as if the scientific process were encompassed in a shroud of secrecy and could be revealed only to the scientist.

Science, however, is not a mysterious phenomenon. Rather, it is a very logical and rigorous method for attempting to gather facts. This chapter is designed to remove the mystery surrounding science and to acquaint you with the scientific process. In this chapter, I will explain not only the meaning of science but also the unique characteristics that distinguish the scientific method from other methods of gathering information.

INTRODUCTION

In our daily lives, we constantly encounter problems and questions relating to the behavior of ourselves and others. For example, one person may have a tremendous fear of taking tests. Another individual may have a problem with marital discord, alcoholism, or drug abuse. People who encounter such problems typically want to eliminate them but often lack the knowledge or ability to handle the problem themselves. Consequently, they seek out professionals, such as psychologists, to help them to remediate such difficulties.

Other people may enlist the assistance of a professional in understanding the behavior of others. For example, salespeople differ greatly in their ability to sell merchandise. One used car salesperson may be capable of selling twice as many cars as another salesperson. If a sales manager could discover why

such differences in ability exist, he or she might be able to develop either better training programs or more effective criteria for the selection of the sales force.

In an attempt to gain information about behavior, people turn to the field of psychology. As you should know by now, a great deal of information about the behavior of organisms has been accumulated. We have knowledge that enables us to treat disorders such as "test anxiety." Similarly, we have identified many of the variables influencing behaviors such as persuasion and aggression. Although we know a great deal about the behavior of humans and infrahumans, there is a great deal yet to be learned. For example, we still have an inadequate understanding of childhood autism and of leadership ability. In order to learn more about such behaviors, we must engage in scientific research because this is the only way in which we can fill the gaps in our knowledge. However, the ability to understand and engage in the research process does not come easily; it is definitely not an ability that comes from taking content courses such as introductory psychology or abnormal psychology. These courses give little insight into the way in which psychological facts and data are acquired. They state implicitly or explicitly that such facts and data were acquired from scientific research, but the nature of the scientific research process itself remains elusive.

In order to learn about the scientific research process, one needs more direct instruction. The course in which you are now enrolled is directed toward providing you with information about the way in which the scientific research process is conducted. Some students may object that such a course is not necessary for their education because they have no intention of becoming research psychologists. But there are a number of very good reasons for all students to study experimental methodology. First, at some time in the future you may be asked to conduct a study (such as a community survey) on some issue. Second, virtually all the material you are required to learn in your science courses is based on knowledge acquired from the scientific method, so you should be familiar with the method. Third, we are all constantly bombarded by the results of scientific research, and we need experimental tools to determine which research outcomes are conclusive. For example, saccharin has been demonstrated to cause cancer in laboratory animals, yet there are many people who consume saccharin and do not contract cancer. You as a consumer must be able to resolve these discrepancies in order to decide whether or not you are going to eat foods containing saccharin.

Similarly, television commercials often present what appears to be a scientific test in order to convince us of the superiority of one product over another. Several years ago the manufacturers of Schlitz beer were concerned with the decline in the sales of their product. In an effort to reverse this decline, the company conducted a live "challenge" on television in which devotees of another brand were challenged to see if they could distinguish their preferred brand from Schlitz. This live demonstration consistently showed that about 50 percent of these beer drinkers chose Schlitz over their preferred brand as the better tasting beer. On the surface, this challenge seems to reveal that Schlitz is an excellent beer because so many people chose it. If you had some knowledge of research design and statistics, however, you would be able to see that this contest did not prove anything about the superiority of Schlitz over other beers because the challenge was conducted on live television, in the midst of a lot of noise and commotion. Such distractions would minimize a person's ability to distinguish one beer from another. If enough distractions existed so that people could not distinguish one beer from another, they would probably select one beer about the same number of times as the other. This is exactly what happened, since Schlitz and the other brand were *each* picked by about 50 percent of the people. From this example, you can see that an understanding of the scientific research process induces a way of thinking that will enable you to critically evaluate the information with which you are confronted. Given that our society is constantly becoming more complex and we are having to rely more and more on scientific evidence, our ability to evaluate the evidence intelligently becomes increasingly important.

METHODS OF ACQUIRING KNOWLEDGE

There are a wide variety of procedures by which we obtain information about a given phenomenon or situation. We acquire a great deal of information from the events we experience as we go through life. Experts also provide us with a lot of information. Helmstadter (1970) has posited that there are at least six different approaches to acquiring knowledge, only one of which is the scientific method. In order to enable you to gain an appreciation of the rigor and accuracy that is achieved by the scientific method, we will begin by taking a look at the

five unscientific approaches to acquiring knowledge and then look at the scientific method. You should be able to see that each successive approach represents a more acceptable means of acquiring knowledge.

Tenacity

Tenacity
Persistence of a superstition

The first approach can be labeled **tenacity**, defined in *Webster's Third New International Dictionary* as "the quality or state of holding fast." This approach to acquiring knowledge seems to boil down to the acquisition and persistence of **superstitions**, because superstitions represent beliefs that are reacted to as if they were fact.

Here is one example of tenacity. Jerry Granville took over as head coach of the Houston Oilers in 1986. The Oilers had been one of the worst teams in professional football, but during the 1986 preseason games something happened. The Oilers won all four of their games, something they had not done for about a decade. During this preseason series, Jerry Granville was wearing black pants, a black shirt, and white shoes. When the regular series was to begin, however, he planned to change from his white shoes to another color. His assistant coaches refused to allow this change because, they said, they were winning, and they did not want to change anything that might affect their continued winning.

The assumption seems to be that the white shoes somehow enhanced the probability of the Oilers winning football games. The Oilers proceeded to beat the Green Bay Packers in their first regular season game, which probably reinforced this superstitious behavior. But they lost the next five or six games, demonstrating the fallacy of using this approach to acquiring information.

Intuition

Intuition
An approach to acquiring knowledge that is not based on reasoning or inferring

Intuition is the second approach to acquiring knowledge. *Webster's Third New International Dictionary* defines **intuition** as "the act or process of coming to direct knowledge or certainty without reasoning or inferring." Psychics such as Edgar Cayce seem to have derived their knowledge from intuition. The predictions and descriptions made by psychics are not based on any known reasoning or inferring process;

therefore, such knowledge must be intuitive knowledge. This does not mean that knowledge acquired from psychics is undesirable or inappropriate—only that it is not scientific knowledge. (In fact, it has been suggested that intuitive thought takes place in the right hemisphere of the brain and logical thinking occurs in the left hemisphere. Consequently, *instruction in the scientific process may involve exercising and using only the left hemisphere.*)

Authority

Authority

A basis for acceptance of information because it is acquired from a highly respected source

Authority as an approach to acquiring knowledge represents an acceptance of information or facts stated by another because that person is a highly respected source. Authority exists within the various religions: A religion typically has a sacred text, tribunal, person, or some combination of these that represents the facts, which are considered indisputable and final. This example is not meant to be critical of religions, but only to demonstrate that the authority approach to gaining knowledge differs from the scientific approach. Another example comes from the political-social arena. On July 4, 1936, the Central Committee of the Communist Party of the Soviet Union issued a "Decree Against Pedology" (Woodworth and Sheehan, 1964), which, among other things, outlawed the use of standardized tests in schools. Since no one had the right to question such a decree, the need to eliminate standardized tests had to be accepted as fact.

The authority approach should not be confused with our increasing dependence on experts for information. Experts do transmit scientific knowledge, and they usually base their opinions on scientific knowledge. The distinction between the authority approach and an appeal to an expert is that the authority approach dictates that we accept whatever is decreed, whereas the appeal to an expert does not dictate such *indis-criminate acceptance*. We are free to accept or reject whatever the expert says.

Rationalism

Rationalism

The acquisition of knowledge through reasoning

A fourth approach to gaining knowledge is **rationalism**. This approach uses reasoning to arrive at knowledge and assumes that valid knowledge is acquired if the correct reasoning