INTRODUCTION TO EXPERIMENTAL PSYCHOLOGY

MATHESON BRUCE BEAUCHAMP

DOUGLAS W. MATHESON
University of the Pacific

RICHARD L. BRUCE
Claremont Men's College

KENNETH L. BEAUCHAMP
University of the Pacific

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PREFACE

Too few undergraduate psychology students know what constitutes an experiment. Often, the word "experiment" conjures up the image of frog dissection in a high school biology class. The student may remember the odor of formaldehyde, and the inevitable lab manual ("cook book") with its step-by-step instructions on the correct procedure for removing the scalpel from the lab kit, placing the frog on the table, etc. Students wander through social or physical science courses, participate in "cook book" laboratories, but do not reach an intuitive level of awareness about how an experiment is conducted. When a student follows an outlined step-by-step procedure of an experiment, he does not have to think about what is going on in the experiment. Because he does not design the experiment, the student often fails to recognize that the basic ingredients of an experiment are the manipulation of independent variables, the control of as many other variables as possible, and the measurement of dependent variables. Students are often not able to discriminate between an experiment where a variable is manipulated and a case study or survey where an independent variable is not manipulated.

We feel that the student should have a strong background in research methodology early in his psychology career so that he can differentiate good from not-so-good research. Of course, with a strong background, a student will be able to conduct experiments. The student, regardless of his area of interest in psychology, must be prepared to recognize and perform well-designed research.

Introduction to Experimental Psychology is designed to acquaint the student with behavioral research procedures. In addition, a section on elementary statistical analysis is provided so that once a student constructs an experimental design and performs his research, he may analyze the data and formulate some conclusions in terms of his hypotheses. Statistical tables are provided to enable the student to quickly evaluate the results of a statistical test.

A unique feature of the text is Section III which contains contemporary research topics or suggestions for research. These research topics were chosen because they are interesting to many students. The topics are only suggestions and need not restrict the teacher or the students' choice of research area. The topics are presented to stimulate thinking about research, but do not represent a cook book, step-by-step outline for study of a particular topic. Since the book does not specify laboratory procedures, the experiments can be adapted to the equipment (and, frequently, the subjects) available.

The book is dedicated to those who appealed to the authority of some "expert" for their ideas. Without these individuals, books of its nature would have been written years ago.

We would like to express our appreciation to Judy Beauchamp who typed the final manuscript and made invaluable contributions to the readability and accuracy of the text. Sue Robbins and Bob Goodman were very helpful in the editing of the manuscript. We are grateful to R. N. Haber, H. R. Schiffman, and J. Jones for their thorough and helpful criticisms of the manuscripts. Thanks are also due Drs. Bruno, Hershey, May, and Shupe who class tested and criticized the preliminary edition. Finally, we would like to express great appreciation to our students at California State Polytechnic College at Pomona, Claremont Mens College, The University of the Pacific, and The University of Southern California who were our most genuine and severe critics, and who motivated us to make this modification of the preliminary edition meaningful to the reader.

The order of the authors' names on the title page of this book was determined with a table of random numbers.

Stockton, California — Douglas W. Matheson
Claremont, California — Richard L. Bruce
Stockton, California — Kenneth L. Beauchamp

February, 1970

PROLOGUE

Fifteen thousand years ago, a caveman was creeping near a herd of woolly mammoths hoping to kill a calf which had wandered away. Intent upon his prey, he hadn't noticed a shift in wind direction until one of the herd bulls bellowed and moved in his direction with trunk upraised and ears widespread. The caveman frantically ran to the nearest large tree and scrambled as high as he could. The bull stormed and trumpeted about the base of the tree, and the caveman knew he would have to stay for some time. As he surveyed the countryside from his perch, he was startled to see a man walking on the trail towards him. The stranger glanced up each time the bull trumpeted, but continued walking. The caveman watched in astonishment as the stranger (the fabled "Weird Harold") came around a bend in the trail, saw the bull, waved cheerfully to the caveman, and proceeded into the clearing. The bull turned and charged Harold, caught him in midstride, and trampled him into the ground. Its rage vented, the bull returned to the herd. The caveman waited a while longer, then descended to the ground. He walked over to the mangled body of Harold, stared at it with a puzzled expression on his face, then shaking his head, disappeared into the forest. The death of the first "madman" had been observed, but instead of attempting to explain Harold's strange behavior, the caveman forgot about it. The story illustrates the worst approach to knowledge: not asking any questions and thus not gaining any knowledge.

An example of a futile approach to knowledge is given in the following quotation.

> In the year of our Lord 1432, there arose a grievous quarrel among the brethren over the number of teeth in the mouth of a horse. For thirteen days the disputation raged without ceasing. All the ancient books and chronicles were fetched out, and wonderful and ponderous erudition, such as was never before heard on in this region, was made manifest. At the beginning of the fourteenth day, a youthful friar of goodly bearing asked his learned superiors for permission to add a word, and straightway, to the wonderment of the disputants, whose deep wisdom he sore vexed, he beseeched them to unbend in a manner coarse and unheard-of, and to look in the open mouth of a horse and find answer to their questionings. At this, their dignity being grievously hurt, they waxed exceedingly wroth; and joining in a mighty uproar, they flew upon him and smote his hip and thigh, and caste him out forthwith. For, said they, surely Satan hath tempted his bold neophyte to declare unholy and unheard-of ways of finding truth contrary to all the teachings of the fathers. After many days of

> grievous strife the dove of peace sat on the assembly, and they as one man, declaring the problem to be an everlasting mystery because of a grievous dearth of historical and theological evidence thereof, so ordered the same writ down.
>
> (Francis Bacon, quoted in Mees, 1934, p. 17.)

The Friars had two methods of determining the number of teeth in a horse's mouth. They could appeal to authority by referring to the ancient chronicles, or they could look into a horse's mouth. Obviously, the "learned superiors" considered the observation of physical events inappropriate when an appeal to a "higher authority" was possible. Such avoidance of observation has characterized the search for knowledge by scholars in many fields of study including the study of behavior. For example, a primitive explanation for abnormal behavior was the assumption that the individual was occupied by demons. Treatment of the mentally ill was based on this assumption. A popular treatment was to have a priest exorcise the resident demon by shouting epithets and foul insults which supposedly so wounded the demon's pride that he would leave. Later treatments included all varieties of torture, starving, and immersion in hot water. The treatments were designed to make the demon so physically uncomfortable that he would seek better accomodations.

The failure to ask questions and the avoidance of observation have been ineffective in advancing knowledge about behavior. A fruitful approach to knowledge has been the scientific approach. The present field of psychology uses the scientific approach in the study of the behavior of man and other animals.

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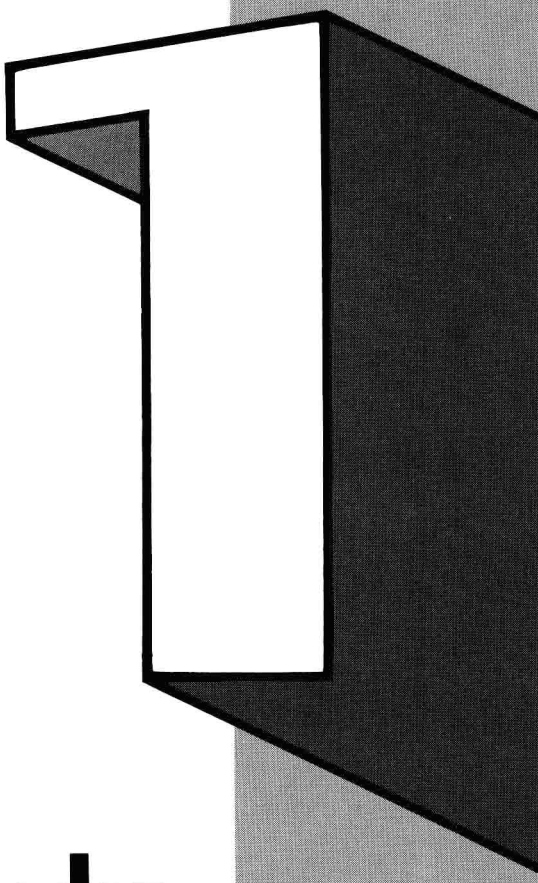

THE SCIENTIFIC APPROACH TO KNOWLEDGE

The scientific approach to knowledge is one of many legitimate ways of collecting information. The sciences differ in terms of their basic subject matter; and the techniques, procedures, and methods used by individual scientists depend on their research problems. However, all scientists: (1) make a few basic assumptions, (2) study only restricted kinds of questions, and (3) have the same general goals. The shared assumptions, restrictions, and goals describe the scientific approach to knowledge.

ASSUMPTIONS OF THE SCIENTIFIC APPROACH

All approaches to knowledge are based on a few assumptions, premises, or basic beliefs. The assumptions of the scientific approach are: (1) order, (2) determinism, and (3) discoverability. Scientists assume that order pervades the universe. **Order** is a primitive, undefined term; however, to say that scientists believe in order is to say that scientists believe events happen in regular patterns. Scientists do not believe that events occur in a chaotic, chance manner.

Scientists assume that the occurrence of an event is determined by prior or antecedent events. The assumption of **determinism** is shared by all scientists; thus, psychologists assume that all behavior is determined. For example, a particular behavior such as choosing to buy one kind of car rather than another is assumed to be a consequence of the previous (antecedent) experiences of an individual.

The assumption of **discoverability** means that scientists expect to find answers to present scientific questions. Psychologists believe that eventually today's research questions about behavior will be answered. Of course, new questions are constantly being formulated, and new research is continually indicating that previously accepted answers are incorrect or incomplete. Therefore, scientific research is a continuous process.

RESTRICTIONS ON SCIENTIFIC OBSERVATION

Scientific observation must satisfy three requirements. First, the observations must be **empirical.** The scientist records relatively objective observations of events. Basic scientific information cannot be composed of speculations about unobserved events. For example, electrons have never been observed, but the effects of electron movement have been observed in a Wilson cloud chamber. In psychology, learning has never been directly observed, but has been inferred from changes in the behavior of an organism. A second requirement is that the basic events and the observation of these events must be **public.** The observed events must occur in a manner, place, and time that allows the possibility of observation by others. The subjective observation of what is happening in one's own "mind" cannot be called scientific observation. Indeed, it is probable that a "mind" cannot directly observe itself (Hebb, 1969).* A third requirement is that the observations must be **repeatable.** An observation by a single individual is not scientific unless it can be repeated. The details of the situation and the elements of

* All references cited in the text, but not in the suggested reading list at the end of each chapter, will be included in a special section at the back of the book.

the observation procedure must be specified in a scientific report.

Two types of observation are used in the scientific approach: naturalistic observation and experimental observation. Both types satisfy the above three restrictions.

Naturalistic Observation

The observation of events in their natural setting is called **naturalistic observation.** (See Chapter 10.) Naturalistic observers examine empirical, public events. Theoretically, these observations are repeatable, given that the events "naturally" occur more than once. The occurrence of the events is independent of the observer's behavior. For example, astronomers are naturalistic observers. The movements of the stars are not under the control of the observer, but they are empirical, public events, and the movements usually recur within a time span that allows a second observation.

Experimental Observation

The observation of events in a restricted setting is called **experimental observation.** Experimental observers make empirical, public, repeatable observations. In addition, experimental observations are made under controlled conditions. By **control** we mean that an experimental scientist manipulates the environment so that the critical events occur at a specified time and place. Manipulation allows the scientist to be fully prepared for precise observation. The experimenter is also assured that events will occur a second time, allowing verification of his observations under the same conditions. Finally, the experimental scientist can systematically vary the physical conditions to discover what changes in the events occur.

The three restrictions (empirical, public, repeatable) indicate that only certain types of problems can be studied with the scientific approach. The necessity for control further limits the experimental scientist. Supposedly, watching violent television shows leads human beings to aggressive behavior such as violent crimes. The problem cannot be directly studied by experiment because a scientist cannot control the rate of watching violent television shows, and he cannot publicly, repeatedly observe individual crimes.

THE GOALS OF THE SCIENTIFIC APPROACH

The three goals of any science are: (1) understanding, (2) prediction, and (3) formulation of a systematic body of knowledge. The general goal of any approach to knowledge is **understanding.** Understanding is a primitive term that defies clear definition in the dictionary sense. However, we all have some intuitive notion of the meaning of the term. For example, when we observe a child avoid a hot stove, we can agree that the child understands the relationship between the act of touching the stove and the resultant pain. Scientific understanding is the tentative acceptance of an explanation for the occurrence of an event. The acceptance is tentative because scientists know that through further testing, another explanation may be developed.

Another goal of the scientific approach is **prediction.** On the basis of a given relationship between two or more events, the scientist specifies their probable future relationship. To a scientist, a prediction is but one step in the entire approach, for all predicted relationships must be tested.

A third goal is the **systematic organization** of empirical evidence into a **body of knowledge.** If a prediction is supported by repeated scientific tests, then the predicted relationship between observable events becomes a scientific fact. A systematic organization of these facts *and* the methods used to obtain them constitutes scientific knowledge.

RESEARCH EXAMPLE

Weil, Zinberg, and Nelson (1968) conducted a series of experiments on the effects of marihuana smoking on human behavior. The research represents the first *experimental study* of marihuana intoxication. Previously, naturalistic observation of marihuana smokers at "pot parties" and incompletely reported observations of soldiers and prisoners indicated that smoking had little effect on tests of manual dexterity, but some effect on physiological measures such as pulse rate, overeating (hyperphagia), and pupil dilation. These observations were formally tested by Weil and his colleagues. They did not set out to prove or disprove popular dogma about marihuana. Rather, they wanted to find out what happens when someone smokes marihuana.

It took one year to get the study approved by university and governmental agencies. After approval was formally granted, it took two months to find nine marihuana-naïve, male subjects, while eight chronic users of marihuana were easily found. All volunteers had to pass a comprehensive psychiatric interview.

The researchers set out to conduct an empirical, public, replicable, and controlled experimental study. The naïve subjects were taught how to smoke the cigarettes. During several sessions, the subjects smoked two cigarettes in a neutral, laboratory setting. The verbal interaction between the subjects and experimenters was minimized, and the physiological and psychological tests were given according to a rigid schedule. The subjects were not asked to describe their feelings about their experiences until after the final experimental session.

The amount smoked was rigidly controlled, and the presumed active agent in marihuana cigarettes was also controlled. At different times, the subjects were given placebos (cigarettes containing hemp without the active agent), low strength cigarettes, and high strength cigarettes. A **double-blind** procedure was used; neither the researchers nor the naïve subjects knew, until afterward, which kind of cigarette was used in a given test session. During the sessions, the subjects smoked the different kinds of cigarettes