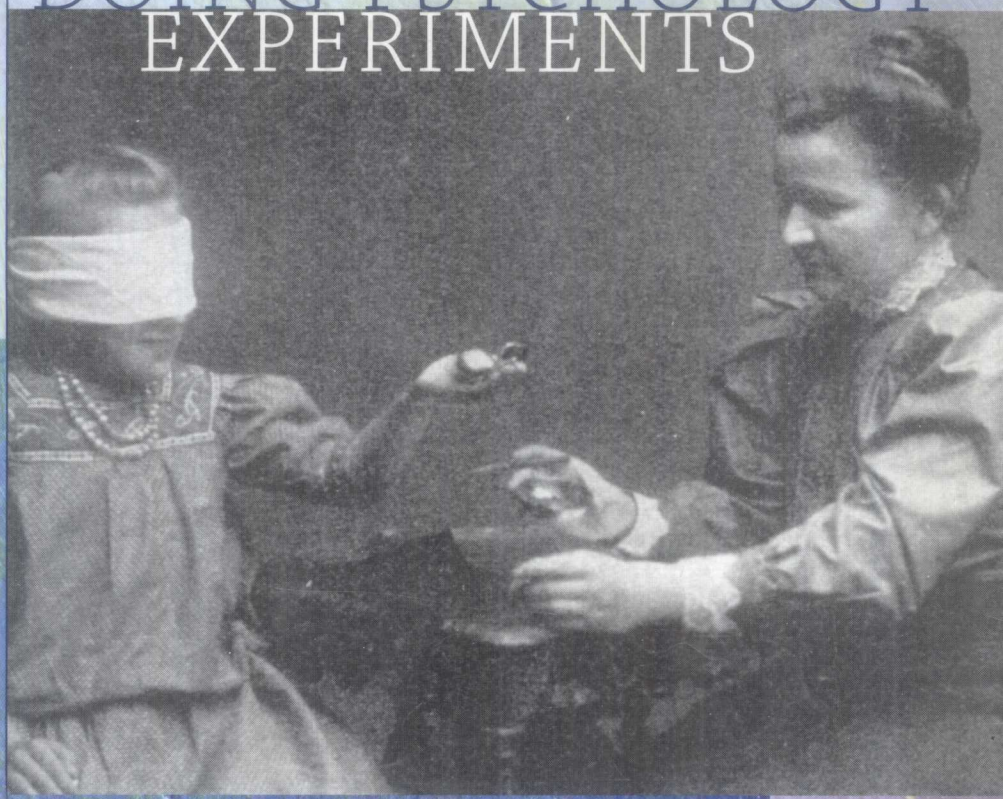
SIXTH EDITION

DOING PSYCHOLOGY EXPERIMENTS



DAVID W. MARTIN

Doing Psychology Experiments

SIXTH EDITION

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PREFACE

Doing Psychology Experiments has now been on the market for 25 years, and it still seems to be fulfilling its original function: to teach students with little or no background in experimentation how to do simple experiments in psychology. Throughout the six editions of the book I have tried to keep the writing style informal and friendly. Although scientific results are usually reported in an objective, impersonal style, I believe that doing experimentation is a highly personal experience. The experimenter reviews the literature and forms a view of the body of knowledge. The experimenter creates the theories and hypotheses for testing. The experimenter decides which variables to manipulate and which to measure. The experimenter interprets the results and determines how the body of knowledge has been advanced. The experimenter is personally involved in the process of experimentation, and I believe that the best way to teach new experimenters about this process is through a personal book.

There has even been some research assessing students' preferences and learning when using more personally written books. For example, Paxton (1997) found that students reading a text with a "visible author" (one who writes in the first person, revealing personal opinions and self) engaged in mental conversations with the author, which led to a closer relationship with the information contained in the text. Lorin Sheppard (2001), a student at Michigan State University, has even studied the use of humor in texts, using material from this book and comparing it to material from a book that had been given, to use her term, a "humorectomy" (personal communication, April 27, 2001). She found that not only did the students report that the humorous chapters were more interesting and informative, but that there was also a tendency for students to recall more items from the humorous version during a delayed recall test. I am pleased that these results support my long-held intuition that both humor and a personal writing style are pedagogically useful.

Now a few words about what this book does and does not do. It provides enough information so that a student with no experimental background will be able to design, execute, interpret, and report simple psychological experiments. Although the book has most often been used for undergraduate courses in experimental methods, it has also been used with other books for other purposes. Several colleges use it for the laboratory section of introductory psychology courses. It is sometimes used in conjunction with a statistics book or a content book for experimental courses with those orientations. It is frequently adopted for undergraduate content

courses (ranging from deviant behavior to consumer psychology) when the instructor requires experiments to be done and the students have little experimental background. I have talked with many users, both instructors and students. They report that the book can be used successfully as a stand-alone text and as a supplement. In fact, in my own experimental methods course, I assign chapters before lecturing on the material, give a little quiz to encourage the students to read the material before class, and then spend lecture time clarifying points where necessary, but mostly discussing experimental proposals and problems. The book does a good job of bringing a diverse set of students up to the same level so that class time can be used for more creative interaction.

Although the book is often used as a supplemental text and may appear physically smaller than some others on the market, it nevertheless does discuss most of the important concepts from experimental methods. I have attempted to provide comprehensive coverage of the area, and some research indicates that the attempt has been successful.*

Authors of textbooks representing many areas of psychology were asked to rate the importance of terms and concepts from their subfields. Of the top 100 ranked terms in the methods/statistics area, 33 emphasized statistics or psychometric testing. Of the remaining 67 that emphasized methods, this book discusses all but 6. Four of those terms are discussed at a conceptual level but using alternative terminology. Only two terms, both ranking in the 90s, are not represented in this book. I believe that this evidence confirms the claim that this book provides comprehensive coverage of experimental methods.

What this book does not do is teach students much about the content and current findings in the various areas of experimental psychology. Many of the examples I use are contrived; they illustrate the methods being discussed, but they are not real and certainly will not give students a representative coverage of the content of experimental psychology. The book also does not teach students much about the intricacies of complex experimental design and statistical analysis. I have tried to keep it simple. Although I discuss the rationale behind descriptive and inferential statistics, the actual statistical operations presented in Appendix A are admittedly cookbookish.

The sixth edition has many small changes. This time I put on a lot of bandaids rather than doing major surgery. At several reviewers' suggestions I rewrote some of the material in Chapter 2 on randomization, especially trying to make a better distinction between random selection and random assignment. I updated some of the material on animal research regulations and institutional review boards in Chapter 4. In Chapter 6 I expanded a bit the discussion of searching electronic databases other than *PsycInfo*, such as *MEDLINE*. In Chapter 7 I included a little more material on fMRI as a dependent variable. At the suggestion of a reviewer who

*Boneau, C. A. (1990). Psychological literacy: A first approximation. *American Psychologist, 45,* 891–900.

argued that many of the methods discussed in Chapter 10 have a long tradition in psychology and hence are not nontraditional, I changed the title to *How to Design Research That Is Not Experimental.* I also made a few changes in the discussion of single-subject and small-*N* baseline designs in response to some concerns expressed by folks who do that kind of research. In Chapter 12 I added a little more discussion of standard deviations and of scale considerations in graphing. Finally, a new *APA Style Manual* has been published since the last edition. While the changes in the manual were not extensive, they did require me to modify some discussion of style rules and the sample report in Chapter 13.

I did keep most of the features from the previous edition. Most instructors report that they very much like the expanded material on doing surveys that I included in the last edition. An added feature of the last edition was also the use of InfoTrac® College Edition. When students purchase the text, they automatically get access to this database for the duration of the course. The database contains recent newspaper, magazine, and journal articles that can be searched using key terms, authors' names, and so forth. Of particular interest for students using this book is access to journal articles and review articles.

In writing this book, I have used contrived examples to illustrate most of the points. I have done so because I believe such examples drive home the point without students having to digest many superfluous details contained in real experiments. The problem with this approach is that students may leave the course never having been exposed to actual journal articles and real research results. For that reason, at the end of each chapter I have included various exercises that encourage students to search the InfoTrac College Edition database to find journal articles illustrating issues raised in that chapter. If they carry out these exercises, by the end of the course students will have considerable experience reading journal articles. Instructors should review students' work to make sure they are indeed using legitimate journal articles rather than magazine or newspaper articles disguised as original research. The InfoTrac College Edition feature can provide a valuable aid for instructors who want to expose their students to the scientific body of knowledge that is psychology.

In making the changes to this edition I have tried very hard to keep the book as short as possible while covering the necessary topics. I do not want the book to seem too imposing to students, and I want to keep it reasonably priced. To those who have used previous editions, I hope you like the changes. To new users, I hope you like the book.

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CONTENTS

1 How to Make Orderly Observations

> Direct, intuitive observation, accompanied by questioning, imagination, or creative intervention, is a limited and misleading prescientific technique.
>
> C. F. MONTE (1975)
>
> The perversity of animate subjects has, of necessity, whelped a remarkable degree of experimental sophistication in the behavioral sciences.
>
> S. N. ROSCOE (1980)

This book is meant to teach you how to do experiments in the science of psychology. Aside from the fact that learning to do this is required of psychology majors at many colleges, why would you want to know how to do psychological experimentation? One reason could be because you plan to become a psychologist, a scientist studying human and, sometimes, animal behavior. The experimental method is one of the major research tools for collecting data to build the scientific body of knowledge in psychology. I will briefly discuss some of the other tools in this book, but most of the book is concerned with how to do experiments.

Even if you do not plan to become a psychologist, learning about the use of experimentation in psychology can help you become a well-educated person and can provide you with useful skills that generalize to a number of careers. For example, suppose you go into the banking business and work your way up to being a vice president. Obviously, some of what you learn in psychology courses can help you succeed because you know something about human relationships. However, what you know about experimentation can also help. Your boss calls you in and says: "As you know, we've just installed all these automatic tellers in our banks. We spent a lot of money on these newfangled machines, but for some reason the customers don't like to use them. I want you to figure out why and make whatever changes are necessary to get them to use the machines." You will see as you read this book that carrying out such an assignment, while not a formal experiment, requires most of the skills needed for doing a psychology experiment. First, you must form several hypotheses about why the automatic tellers are not being used:

Do the customers feel depersonalized interacting with a machine? Are they intimidated? Do they not know how to use them? Do they feel less safe carrying their money around without the security of another person present? As a second step, some sort of data must be collected to narrow down the possible hypotheses, perhaps by doing interviews or using a questionnaire. Then you would probably want to make a manipulation to see whether you can change the customers' behavior: perhaps offering an educational program, if knowledge is a problem; perhaps giving prizes, if motivation is a problem; perhaps increasing privacy, if security is a problem. Finally, you would want to measure customers' behavior to see whether it changes with your manipulation and to determine whether any such change is meaningful. Although your boss did not ask you to do a psychology experiment, you have carried out most of the steps required to do one. Most jobs require the solving of people problems, and the skills you learn from this book should make you a better people-problem solver.

If you do wish to become a psychologist, the reasons for learning about research and experimentation are probably obvious. Certainly if you want to be an experimental psychologist, then doing experiments will be your main activity and you will repeatedly use the techniques taught in this book. But even if you plan on becoming a clinician or a counselor, at the very least you should know how psychological research is done; ideally, you should be able to do it. One of the major characteristics that distinguish clinical psychologists from others who do therapy, such as social workers and psychiatrists, is how closely tied to behavioral data they are. Early in the history of clinical training, some 50 years ago, educators got together and decided that clinical psychology students should be trained first as scientists and then as therapists, that without the science they would just be guessing about which therapeutic techniques work and which do not. That is why most clinical psychologists get a Ph.D. (doctor of philosophy), a research degree. It is true that today about a quarter of clinical psychologists get a Psy. D. (doctor of psychology) rather than a Ph.D. However, the curriculum for this degree still requires students to be thoroughly versed in research methods. Clinicians must be able to understand research and experimentation or they will not be able to determine the effectiveness of various treatments or to evaluate new interventions as they are introduced. Learning about experimentation is extremely important for future clinicians.

Over and above these practical reasons for learning to do psychology experiments, I hope that part of the reason you want to learn these skills is just because it's fun! We are all curious about the world around us. We want to know why things happen as they do. Humans invented science in order to better understand their world.[1] Science is an attempt to approach this discovery process in an orderly way. Early in life I found out that, for me, experimentation was the most intriguing tool of science because it leads to the discovery of relationships that have never been known. Then when I learned

[1]And, in the case of astronomy, other worlds as well.

about the science of psychology, I further discovered that this powerful tool could be used to understand what I considered to be the most interesting subject of all, human behavior.

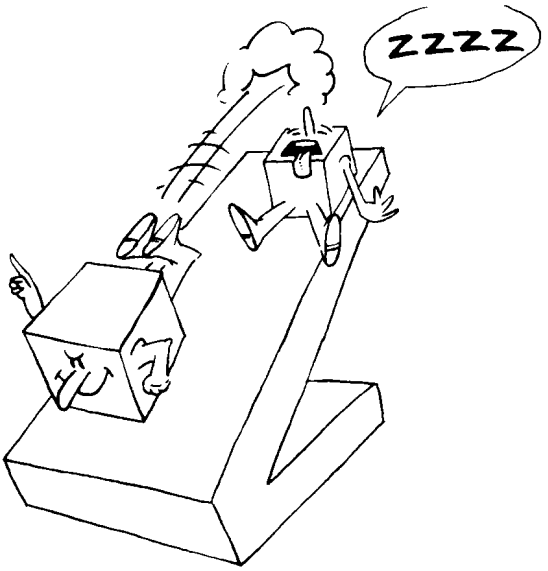
Most people are very curious about their own behavior and the behavior of others. That is why we watch soap operas, gossip behind people's backs, fantasize, and read the *National Enquirer* in the grocery line—to speculate about human behavior. The use of experimentation in psychology allows us to check our speculations. What a thrill it was during my first course in experimental psychology to find scientific relationships that nobody else had ever seen. Even after years of doing experiments, my heart beats a little stronger when I get that first look at the results of a new experiment. My colleagues probably get tired of my running to their offices to show them the exciting discoveries as they unfold in my lab. I hope that you feel the same excitement when you do your research. Although there are more serious reasons for doing the science of psychology, may you always continue to appreciate the fun of experimentation.

Psychology as a Science

Psychologists go about their business much as scientists do in other scientific fields. In their search for an understanding of human behavior, psychologists attempt to (1) **establish relationships between circumstances and behaviors** and (2) **fit these relationships into an orderly body of knowledge.** In this book we will deal primarily with the first activity, although we will touch on the second activity in Chapters 3 and 13.

What kind of relationship is acceptable to us as scientists? When we can demonstrate that one event is related to a second event in some predictable way, we have a statement that will fit into the scientific body of knowledge. At least one of these events must be a measurable behavior. Here we can make a distinction among the sciences. The behavior of major concern to us as psychologists is human behavior (and sometimes animal behavior). And this is where we run into a problem that haunts psychologists but not physical scientists. Humans and animals are variable. We humans often cannot repeat a response precisely even if we wish to, and in some cases we may not wish to. In terms of variability, physical scientists typically have it easier than psychologists.

A physicist measuring the coefficient of friction for a wooden block might measure the time it takes the block to slide down an inclined plane. Although the times might vary from trial to trial, such variability would be relatively small. The physicist would not be making too great an error if he or she considered the variability a minor nuisance and measured the time for only one trial. However, a psychologist who wanted to measure the time it takes a human to press a button in response to a light would be making a considerably greater error by ignoring human variability. Although it is unlikely that our physicist's block will be a little slow on certain trials because it has its



mind on other things, isn't ready, or is blinking or asleep, a human can experience these and many other problems.

In addition to variability among trials, variability among humans must also be taken into account by psychologists. Our physicist could construct another block of the same size, weight, and surface finish as the original and repeat the experiment. The psychologist, however, cannot re-create humans. Humans seldom have exactly the same genetic background (identical twins being an exception), and they never have exactly the same environmental background. For this reason, in responding to the light, typically one individual's fastest response is considerably slower than another individual's slowest response. Thus, as psychologists we have to deal not only with one person's variability from trial to trial but also with the variability among humans.[2]

One way to handle variability is to use statistical techniques. Many psychology students learn to do this by taking a statistics class early in their course work. Because this is not a statistics text, we will not spend much time considering statistical solutions. The topic is briefly mentioned in Chapter 12, where interpreting the results of experiments is discussed, and in Appendix A, where simple statistical operations are demonstrated. A second way to handle variability is to control it as much as possible in the design of your

[2]You can see why some psychologists decide to use animals in experiments. Whereas psychologists can breed animals with similar genetic characteristics and rear them in similar environments, it would be frowned upon if they tried to do the same thing with humans. Your friends may say, "All men are animals" or "All women are alike," but don't believe them!

research. This book is written to help you do good research, which means knowing where the variability is and being able to account for it.

Psychologists and other social scientists use a variety of research techniques to make orderly observations in an attempt to account for variability. In this chapter I will give you an overview of these techniques.

In the next chapter and in most of the rest of the book I will expand on experimentation, because that is the main technique emphasized in this book. In Chapter 10 I will also go into more detail about several research techniques that are not experimental: questionnaires, single-subject designs, and quasi-experimental designs.

The most widely used research techniques are sometimes called **quantitative designs,** those in which events can be quantified so that the data end up being numbers. These designs include experiments and correlational observations. In order to give you a complete picture of the research techniques available, in this chapter we will also briefly look at **qualitative designs,** in which the events being studied are not easily converted into numbers.

Quantitative Designs

THE EXPERIMENTAL METHOD

As scientists we establish relationships between events, but these events are not always behaviors. In fact, when we do an experiment, or use the **experimental method,** the relationship of interest is between a set of circumstances and a behavior. A physicist wants to know the time it takes a block to slide down a plane when the plane is at a particular angle, has a particular surface, and has a particular temperature. A psychologist, on the other hand, may want to study students' behavior in a classroom. Both scientists are attempting to establish relationships between a set of circumstances and a behavior, the behavior of a physical object or a human. These relationships are scientific facts, the building blocks with which we build our science.

Unfortunately, designing an experiment to establish such a relationship is not always easy. Ideally, we would like to specify exhaustively and precisely a particular set of circumstances and then measure all the behaviors taking place under those circumstances. We could then say that whenever this set of circumstances recurred, the same behaviors would result. However, if we could list *all* the circumstances, we would have a unique set that wouldn't ever recur. Again if we wanted to study students in a classroom, what circumstances would interest us? Perhaps we would like to know the effect of the teacher's sex, or the type of clothes the teacher wears, or the effect of class size, or the use of computers in the classroom, or what time of day the class meets. As you can see, there are many circumstances we might like to investigate. In fact, there is an infinite number of circumstances, and these form a unique set that would never be repeated.

As is the case with the physicist, the psychologist wants to relate circumstances to behaviors, and here a similar problem arises. Which behaviors do we want to investigate? Perhaps how attentive the students are, or how many notes the students are taking, or how many questions the students ask, or class attendance, or even what type of brainwave activity students are producing. Again, as with the circumstances, there is an infinite number of behaviors that we might choose to measure.

Thus, we are caught in a dilemma. On one hand, we want to build our science on statements of precise relationships between circumstances and behaviors. On the other hand, if we did that, we would end up with an infinite number of statements, one for each unique set of circumstances paired with each of an infinite number of behaviors. Although we would have precise statements about the relationship between circumstances and behaviors, we would never be able to predict future behavior from circumstances because we would never again find those particular circumstances paired with a particular behavior. How do we resolve this paradox?

Scientists have had to make a compromise. They choose only a few circumstances to investigate at any one time and let the other circumstances form a general set of circumstances. That means that the circumstance (or circumstances) of most interest is precisely specified, whereas the other circumstances form a general set. In this way the circumstances no longer form a unique set but rather a general set that can recur repeatedly.

In using the experimental method the **scientist manipulates at least one of the circumstances and measures at least one behavior.** For example, suppose we were interested in finding out whether words or pictures are easier to remember. We might make up lists of words like *car, tree, house,* and *hand* and then find simple pictures or line drawings of each of these words. We could then present either the word list or the picture list to people and find out how many trials it takes them to learn each type of list. So we have chosen a circumstance to manipulate and set it at two levels—words versus pictures—and measured trials to learn. In this way, when we have done our experiment, we should be able to make a clear statement about whether presenting material as words or pictures has any effect on ability to learn the material. It is true that we cannot just ignore all the other circumstances. As we will see in the next chapter, we have to consider carefully how to handle the circumstances we are not manipulating. However, when **an experiment is done correctly, it is possible to make a clear statement that any change in the measured behavior that occurs when the circumstance of interest is manipulated is caused by that manipulation.** The reason that the experimental method is so widely used in science is that no other method allows us to make such a strong causal statement. As you will see when we discuss the other scientific methods in this chapter, they all fall a little short of the ideal, being able to say unequivocally that the change in the circumstance *caused* the change in the behavior.