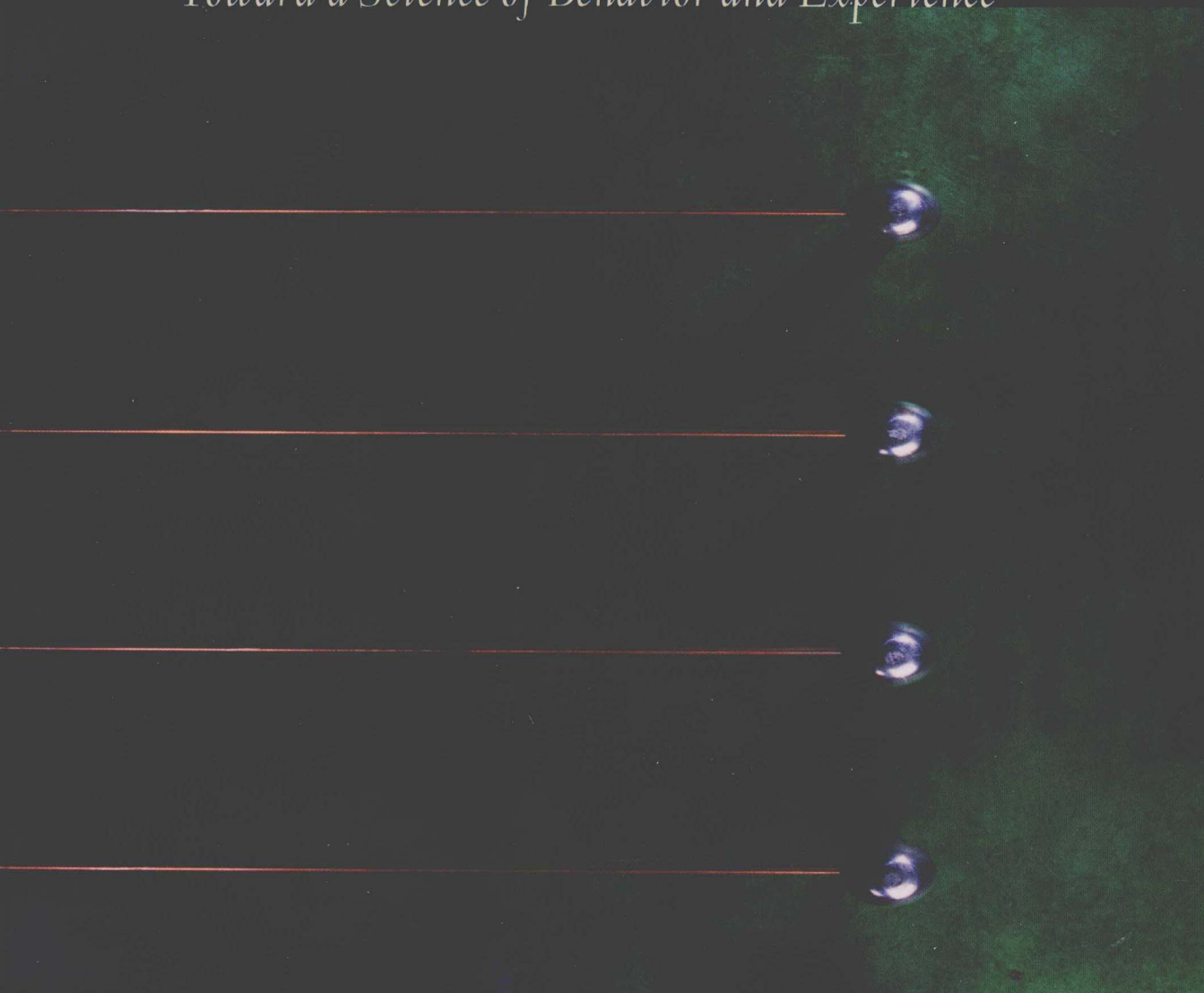
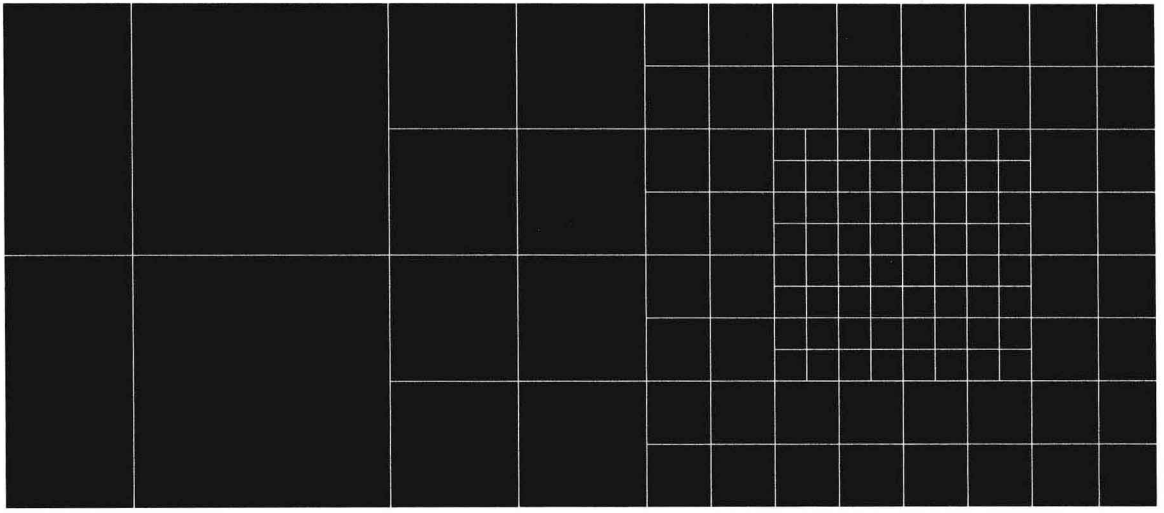
6TH EDITION

William J. Ray

Methods

Toward a Science of Behavior and Experience





SIXTH EDITION

METHODS TOWARD A SCIENCE OF BEHAVIOR AND EXPERIENCE

WILLIAM J. RAY
The Pennsylvania State University

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Cover Designer: Ross Carron
Cover Image: PhotoDisc
Printer/Binder: RR Donnelley & Sons/Crawfordsville

Printed in the United States of America

1 2 3 4 5 6 7 03 02 01 00

Library of Congress Cataloging-in-Publication Data
Ray, William J.
Methods : toward a science of behavior and experience/ William J. Ray.—6th ed.
p. cm.
Includes bibliographical references and index.
ISBN 0-534-35721-0
1. Psychology—Research—Methodology. 2. Psychology, Experimental. I. Title.
BF76.5.R38 1999
150'.7'2—dc21 99-34371

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This book is printed on acid-free recycled paper.

PREFACE

We live in a time when books on science and the nature of ourselves and our world are setting sales records. For many individuals, science offers an exciting understanding of reality. Society itself is also calling on science for answers to difficult questions. Given problems ranging from AIDS to diminishing energy resources to crime to the effect of psychological processes on health and disease, scientists are being asked to present solutions and help shape policy. Despite this great interest in science, the experimental course remains the one that some students dread and put off until the last minute. This seemed strange to us, since many of our colleagues are excited about what they do in psychology and approach research with a real desire to know. This made us think that, in the process of teaching psychological research, we, as faculty, have neglected to include a complete understanding of science, including our own experience in psychology, and especially our reasons for attempting a science of behavior and experience in the first place. Thus, one of our major goals in writing this book was to introduce students to the basics of doing science and to the spirit that motivates many scientists. A second goal was to help students make the transition from viewing themselves as outside observers of science to those who participate in the process of science.

The responses of students and colleagues to the first five editions of this book have been persuasive in suggesting that these initial goals are being accomplished. That is, it is possible to produce a highly readable book that students are able to learn from, and when they are done, they will carry with them a greater understanding of the techniques of science as well as the experience of doing science. As we have moved through the various editions of this book, we have seen psychology change in its approach and subject matter. The current edition reflects many of these changes. This book began with Dick Ravizza as a co-author, and that first edition reflected, as have the later ones, important discussions between the two of us concerning the nature of science, the nature of psychology, and at times, the nature of life. Since that time, these discussions have been continued with colleagues, students, reviewers, and almost anyone else who would listen and discuss these issues. For this reason, the plural "we" has been retained throughout all editions of this book. It is an ever-changing "we," some of whom are acknowledged at the conclusion of this preface, who continue to suggest clarifications, new information, and additional changes that contribute to the overall quality of this book.

The Sixth Edition

Every chapter in this edition has been revised. In particular, we sought to include an increasingly important information resource, that of the World Wide Web, and to offer links to relevant research sites. Also included with this book is access to InfoTrac

College Edition which is a wide ranging source of information including encyclopedias, reference books, magazines, and scientific journals accessed through the Web. Although exercises with InfoTrac College Edition are included at the end of each chapter, faculty can also supplement specific topic areas of their own interest through these resources including the use of online research articles. As with every edition of this book, examples and research studies have been updated and clarifications have been added to help students in their learning. Over the past decade, we have seen a shift in the teaching of this course, with a growing number of colleges and universities presenting the methods course in a large lecture format. In response to this, we have followed the suggestions of faculty and students to clarify the presentation of some of the more important or difficult concepts through illustration and extended discussion. Let me briefly describe the goals and directions, which we have continued in this sixth edition.

Philosophy of Science

One idea we try to convey from the very beginning is the relationship of science and philosophy. We do this not only through the introduction of propositional logic in Chapter 2, but through a discussion of individuals who have shaped our ideas about science. For example, in the first two chapters, students are introduced to not only Newton's rules of reasoning, but the views of Karl Popper and Thomas Kuhn on how science works. We also show students how some approaches to science, such as the use of strong inference and the development of a research program, have allowed certain fields to move at an accelerated rate. Likewise, we show that science cannot be performed without reference to values. We do this not only in our discussion of the ecology of the experimental situation in Chapter 10 and our discussion of ethics in Chapter 14, but throughout the text.

However useful, abstractions alone do not teach students about science as it is practiced, much less how to practice science themselves; thus we also emphasize the concrete. We attempt to involve the student earlier in the process of experimentation in this edition. For example, in Chapter 3, I include detailed information on how to use major library reference works such as *PsycINFO, Science Citation Index, Social Science Citation Index,* and the information available from the National Library of Medicine (e.g., *MedLINE*). Since most researchers access this information from the Web, a discussion of Internet resources is also discussed. However, we still need basics. In our discussion of descriptive statistics in Chapter 4, we teach students how to read and plot graphs. In Chapter 15, I not only teach students how to write up an experiment, but I also include a valuable checklist that can be used for writing an article and presenting a research proposal. Numerous examples from published articles also are included. Because of our desire to make science concrete, we have included interviews with active psychologists on how they first obtained the ideas for their studies. These interviews are followed by a discussion of how to turn an idea into a testable hypothesis.

The Logic of Making Testable Hypotheses

Although most students grasp the idea of asking testable questions, they often have an uncertainty of what exactly it is they are testing in research. To help clarify this

point, we have presented the process of hypothesis testing both conceptually and practically. In Chapter 5, we present a conceptual understanding of inferential statistics and probability. We likewise stress the process of making decisions and the importance of logically ruling out alternative hypotheses. Although this process begins in the first chapter and continues throughout the book, Chapter 2 emphasizes the use of logic and drawing conclusions. This information is important not only for those who seek a career in research but also for anyone who wishes to understand the daily headlines involving scientific research.

Discussion of Various Designs, Including Correlational Designs

An understanding of the logic of experimental design, including the concept of control as well as the process of making inferences, remains the heart of the present edition. However, we have also expanded our discussion of procedures to employ when the experimental situation does not allow for traditional experimental designs. For example, in the present edition we have expanded our coverage of correlational designs to reflect the ways in which such areas as behavioral medicine and developmental and social psychology rely on such approaches. We have likewise expanded our discussion of single subject designs in the chapter devoted to this topic. As in the previous edition, information on quasi-experimental approaches and naturalistic observation is also included. An entire chapter (Chapter 13) is devoted to questionnaires, survey research, and sampling, which provides students with a basic understanding of how to construct questionnaires and the logic involved in sampling procedures.

Clarification of Important Concepts

To help faculty teach this course and students understand the material better, we have made a special effort to define and illustrate what I know to be general problem areas for students. Also, we have included material at the end of each chapter that not only summarizes the main points in the chapter but also includes questions to test comprehension and discussion questions and projects for better integration of the material. Included in this section are designs for the students to criticize and conclusions to evaluate. My talks with faculty across the country have led me to pay special attention to certain topics. For example, the concept of interaction effect is not only illustrated with research examples, but numerous possible outcomes are graphically represented. Given that an understanding of interaction effects continues to be a major problem for students, we have added even more actual examples from the literature in this present edition. We also carefully walk students through the interpretation of interaction effects. These discussions are facilitated by our explanation of the concept behind the *F*-ratio. Beginning in Chapter 6 and continuing throughout the rest of the text, the logic of the *F*-ratio is used in our discussions of experimental control and variation. By emphasizing the factors that influence either the numerator or the denominator of the *F*-ratio, students are able to grasp conceptually what factors will influence their acceptance or rejection of the null hypothesis. We give special attention to two other problem areas for students: the meaning of causation in science and the use of the terms *error* and *chance* in relation to experimentation.

New Directions

In using the title *Methods Toward A Science of Behavior and Experience,* we wanted to convey a sense not only of where experimental psychology has been, but of where it might be going. We expand on this idea in Chapter 16, in which we discuss the potential for a scientific psychology. We point out that psychology was once almost a battleground for those who were interested in behavior and those interested in experience. But today, with scientific studies of such topics as attention, emotion, awareness, animal cognition, and especially consciousness, we see a new group of scientists who are interested in both behavior and experience, not only in others but in themselves.

Acknowledgments

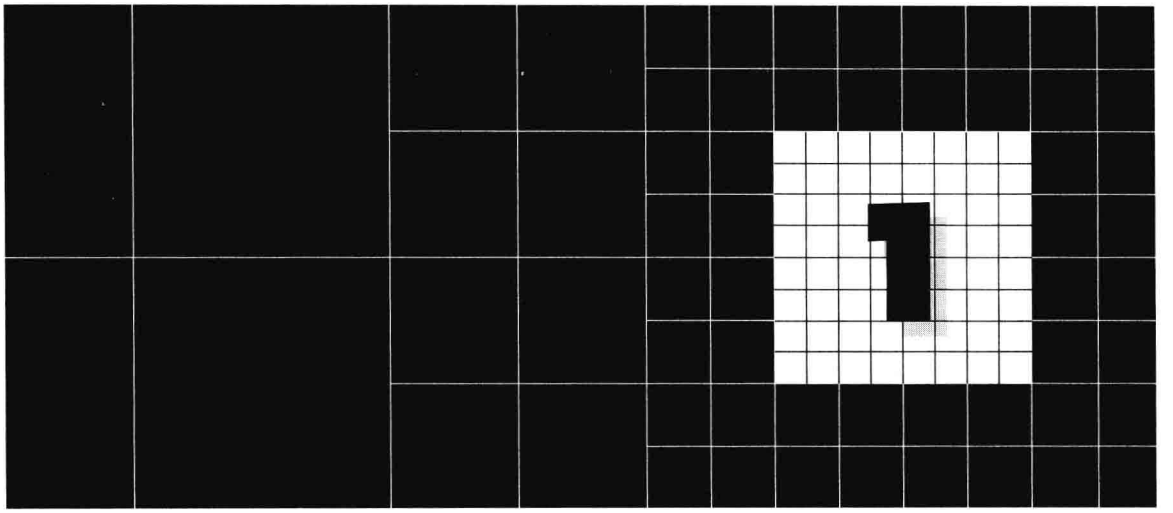
This book grew out of discussions concerning our experience of science and the role it currently plays in psychology. At this time, I would like to acknowledge the many individuals who joined me in these discussions. In relation to the first edition, Dale Harris spent his time discussing his perspective on the history of the experimental movement in psychology. I appreciate the willingness of Jude Cassidy, Jeff Parker, Nora Newcombe, Carolyn Sherif and Lance Shotland to discuss how their ideas came about and how they began their important research programs. I appreciate the help of our colleague Mel Mark for his careful reading of and critical suggestions on the chapters related to inferential statistics and survey research. I also appreciate Judith Kroll's willingness to share with me her notes and ideas for helping women to find more of a home in science and Gordon Hall's perspective on multicultural research. Many colleagues at Penn State and other institutions both in this country and in Europe have shared with me knowledge and experiences in doing science. Others told me ways that they use to teach experimental methods as well as the values they wish to impart. For their time and thoughtful consideration, I am extremely appreciative.

There are many colleagues around the country who shared their experience of teaching with us and made this book richer in many ways. I appreciate their careful reading of the earlier editions and their invaluable suggestions based on their experience with the book. In particular I would like to acknowledge the reviewers of the first edition: Robert T. Brown, University of North Carolina, Wilmington; Dennis Cogan, Texas Tech University; Paul Eskildsen, San Francisco State University; Henry Gorman, Austin College; Les Herold, California State University, San Bernardino; Alan C. Kamil, University of Massachusetts; Nancy Kirkland, Trinity College; Elizabeth Lynn, San Diego State University; Henry Morlock, SUNY, Plattsburgh; Howard B. Orenstein, Western Maryland College; Ronald Rossi, Lyndon State College; Mark S. Sanders, California State University, Northridge; Kathryn Schwarz, Scottsdale Community College; Keith Stanovich, Oakland University; Barbara Tabachnick, California State University, Northridge; W. Scott Terry, University of North Carolina, Charlotte; and Sheila Zipf, San Francisco State University. I would also like to thank the reviewers of the second edition: Earl Babble, Chapman College; Elizabeth Capaldi, Purdue University; Elvis C. Jones, Frostburg State College; John M. Knight, Central State University; Judith E. Larkin, Canisius College; John J. Meryman, San Jose State University; Thomas O. Nelson, University of Washington; and Mark A. Sabol, Creighton University. And I express

our gratitude to the reviewers of the third edition: Philip G. Benson, New Mexico State University; Alexis Collier, Ohio State University; Eric S. Knowles, University of Arkansas; Mark D. Pagel, Oxford University; Kirk H. Smith, Bowling Green State University; and Marty Wall, University of Toronto. The comments of reviewers for the fourth edition have resulted in a number of major changes. Reviewers for that edition included Jonathon D. Brown, University of Washington; Clarke A. Burnham, University of Texas at Austin; Henry A. Cross, Colorado State University; Raymond T. Garza, University of California–Riverside; Mary Gauvain, Scripps College; Elizabeth L. Glisky, University of Arizona; Joellen T. Hartley, California State University–Long Beach; Alan C. Kamil, University of Nebraska–Lincoln; Philipp J. Kraemer, University of Kentucky; W. Trammell Neill, Adelphi University; Howard A. Rollins Jr., Emory University; and Barry S. Stein, Tennessee Technological University. Reviewers for the fifth edition include Deane Aikins, Pennsylvania State University; Steve Buck, University of Washington; Nancy Eldred, San Jose State University; Philip Freedman, University of Illinois; Michael Gaynor, Bloomsburg University; Elizabeth Glisky, University of Arizona; Judith Kroll, Pennsylvania State University; Mark Pitt, Ohio State University; Joseph F. Sturr, Syracuse University; and Jenny Wiley, Virginia Commonwealth University. Reviewing is somewhat of a lost art and I appreciate the consideration given this present edition by our reviewers who include Kevin Apple, James Madison University; Jill Booker, University of Indianapolis; Martin Bourgeois, University of Wyoming; Cynthia L. Crown, Xavier University; Lisa Fournier, Washington State University; Elizabeth Yost Hammer, Belmont University; Kurt A. Hoffman, University of California–Davis; Richard F. Martell, Montana State University; Debra L. Valencia-Laver, California Polytechnic University–San Luis Obispo; Heidi A. Wayment, Northern Arizona University; and Doug Wedell, University of South Carolina–Columbia. I hope the book has not suffered from our inability to implement all of their suggestions.

I found the production staff at Wadsworth and Brooks/Cole to be excellent and wish to thank them for their efforts. It is never an easy task to turn a manuscript into a finished product, and such efforts often go unnoticed. I also appreciate my association with Vicki Knight, the psychology editor at Wadsworth, for her consistent concern with quality publishing. Finally, I would like to invite both students and faculty to write me with their comments concerning the book or examples from their courses or the literature that have helped to clarify the material. You can write me at the Department of Psychology, Penn State University, University Park, PA 16802 or send an e-mail to wjr@psu.edu. I will do my best to include your suggestions in the next edition.

Contents



What Is Science?