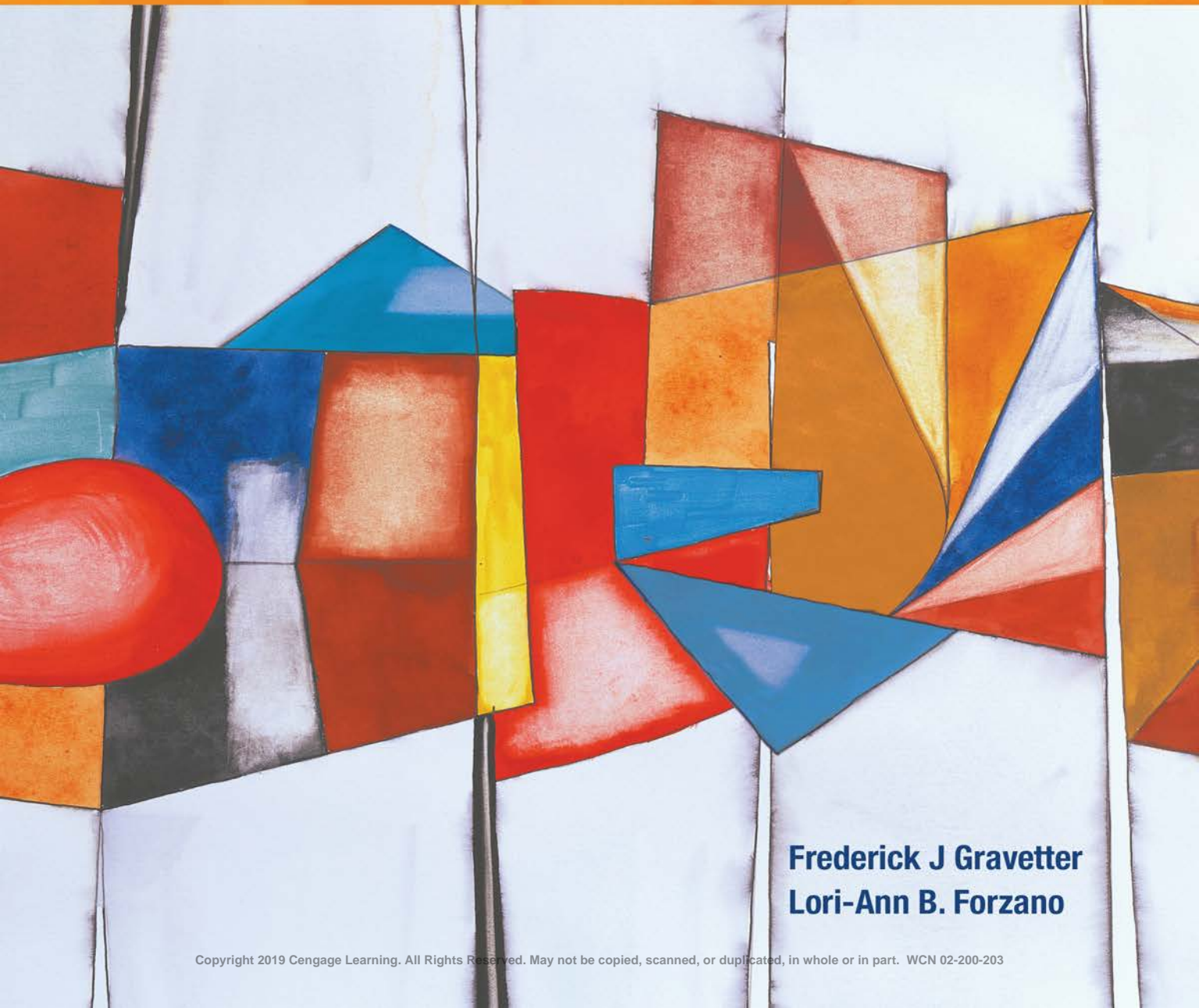
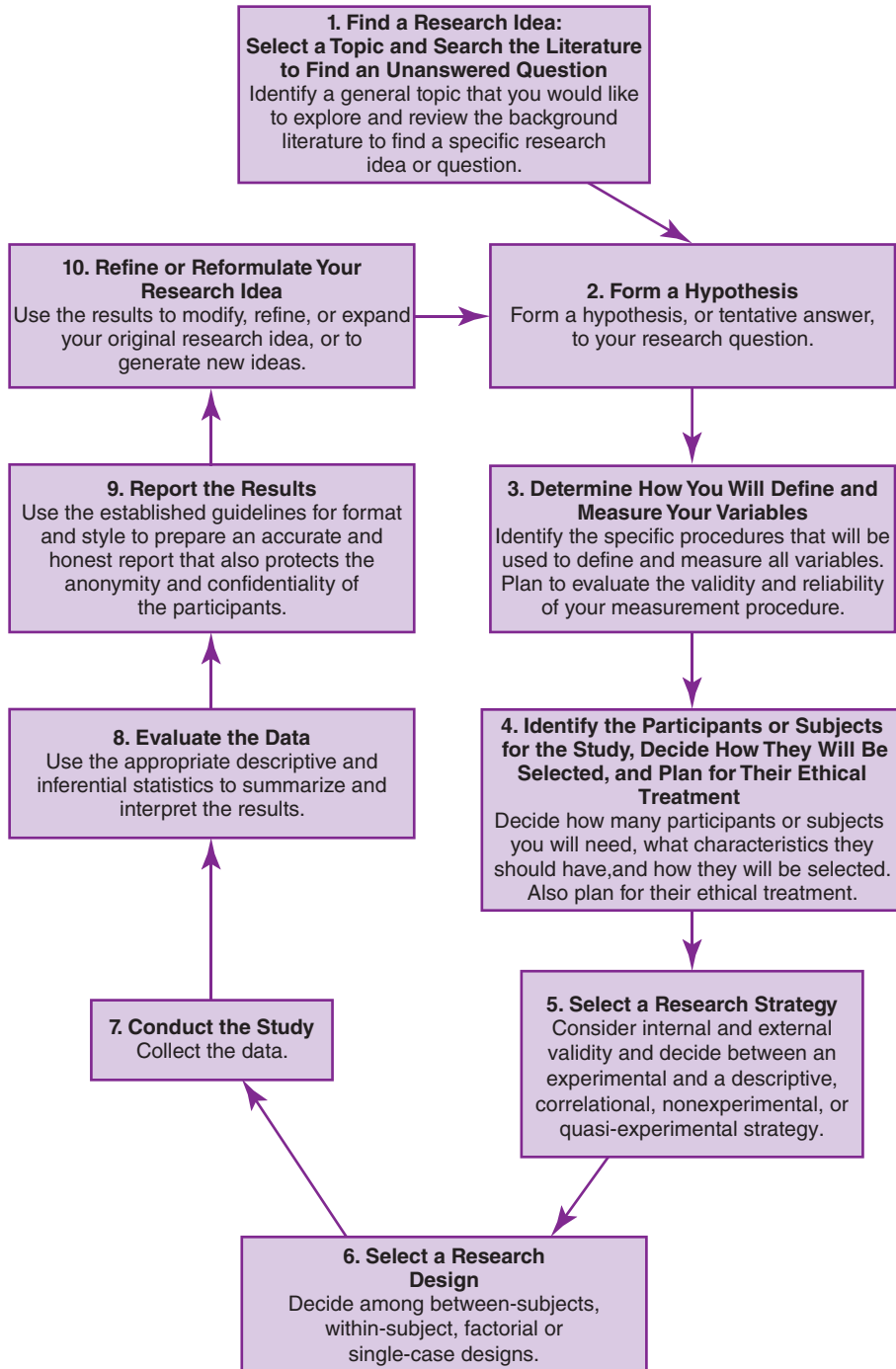


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**Frederick J Gravetter**  
**Lori-Ann B. Forzano**

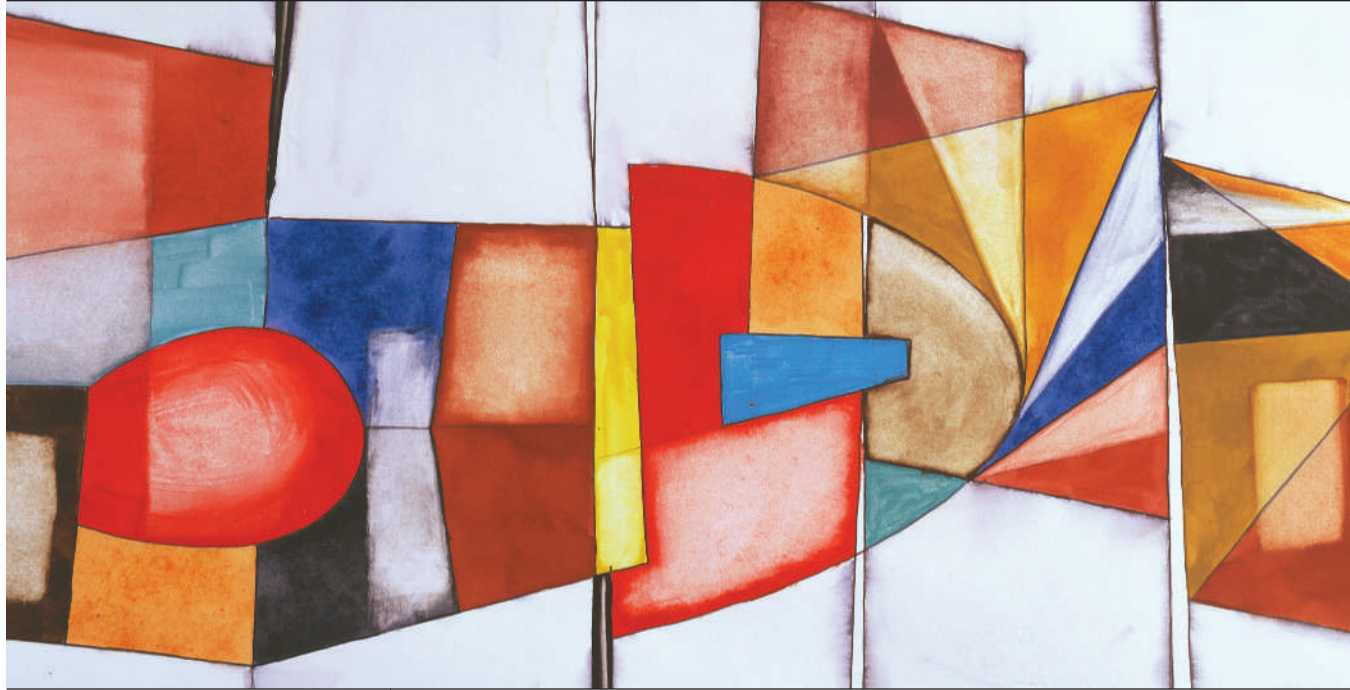


**The Steps in the Research Process**

EDITION

6

# Research Methods FOR THE Behavioral Sciences



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# BRIEF CONTENTS

Preface xvii

About the Authors xxv

- 1** Introduction, Acquiring Knowledge, and the Scientific Method 1
- 2** Research Ideas and Hypotheses 29
- 3** Defining and Measuring Variables 51
- 4** Ethics in Research 81
- 5** Selecting Research Participants 109
- 6** Research Strategies and Validity 127
- 7** The Experimental Research Strategy 157
- 8** Experimental Designs: Between-Subjects Design 185
- 9** Experimental Designs: Within-Subjects Design 211
- 10** The Nonexperimental and Quasi-Experimental Strategies:  
Nonequivalent Group, Pre–Post, and Developmental Designs 237
- 11** Factorial Designs 265
- 12** The Correlational Research Strategy 295
- 13** The Descriptive Research Strategy 313
- 14** Single-Case Experimental Research Designs 341
- 15** Statistical Evaluation of Data 373
- 16** Writing an APA-Style Research Report 421

## APPENDICES

- A** Random Number Table and Instruction 449
- B** Statistics Demonstrations and Statistical Tables 453
- C** Instructions for Using SPSS 481
- D** Sample APA-Style Research Report Manuscript for Publication 501

Glossary 511

References 525

Name Index 533

subject Index 535



Preface xvii  
About the Authors xxv

## CHAPTER 1 Introduction, Acquiring Knowledge, and the Scientific Method 1



### CHAPTER LEARNING OBJECTIVES 1

### CHAPTER OVERVIEW 2

#### 1.1 Methods of Knowing and Acquiring Knowledge 2

The Method of Tenacity 3  
The Method of Intuition 3  
The Method of Authority 4  
The Rational Method 6  
The Empirical Method 7  
Summary 9

#### 1.2 The Scientific Method 10

The Steps of the Scientific Method 11  
Other Elements of the Scientific Method 14  
Science versus Pseudoscience 17

#### 1.3 The Research Process 18

Quantitative and Qualitative Research 18  
The Steps of the Research Process 19

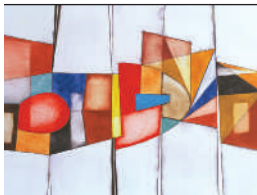
Chapter Summary 26

Key Words 26

Exercises 27

Learning Check Answers 27

## CHAPTER 2 Research Ideas and Hypotheses 29



### CHAPTER LEARNING OBJECTIVES 29

### CHAPTER OVERVIEW 30

#### 2.1 Getting Started: Identifying a Topic Area 31

Common Sources of Research Topics 31

#### 2.2 Searching the Existing Research Literature in a Topic Area 33



	Tips for Starting a Review of the Literature	34
	Primary and Secondary Sources	36
	The Purpose of a Literature Search	37
	Conducting a Literature Search	37
	Using Online Databases	39
	Using PsycINFO	39
	Screening Articles during a Literature Search	40
	Ending a Literature Search	41
<b>2.3</b>	<b>Finding an Idea for a Research Study from a Published Research Article</b>	<b>42</b>
	Find Suggestions for Future Research	42
	Combine or Contrast Existing Results	42
	The Components of a Research Article—Critical Reading	42
<b>2.4</b>	<b>Using a Research Idea to Form a Hypothesis and Create a Research Study</b>	<b>45</b>
	Characteristics of a Good Hypothesis	45
	Using a Hypothesis to Create a Research Study	48
	<b>Chapter Summary</b>	<b>49</b>
	<b>Key Words</b>	<b>49</b>
	<b>Exercises</b>	<b>49</b>
	<b>Learning Check Answers</b>	<b>50</b>

## CHAPTER 3 Defining and Measuring Variables

51



### CHAPTER LEARNING OBJECTIVES 51

### CHAPTER OVERVIEW 52

<b>3.1</b>	<b>Constructs and Operational Definitions</b>	<b>52</b>
	Theories and Constructs	53
	Operational Definitions	54
	Limitations of Operational Definitions	54
	Using Operational Definitions	55
<b>3.2</b>	<b>Validity and Reliability of Measurement</b>	<b>56</b>
	Consistency of a Relationship	57
	Validity of Measurement	58
	Reliability of Measurement	61
	The Relationship between Reliability and Validity	64
<b>3.3</b>	<b>Scales of Measurement</b>	<b>65</b>
	The Nominal Scale	66
	The Ordinal Scale	66
	Interval and Ratio Scales	66
	Selecting a Scale of Measurement	68
<b>3.4</b>	<b>Modalities of Measurement</b>	<b>69</b>
	Self-Report Measures	70
	Physiological Measures	70
	Behavioral Measures	70

**3.5 Other Aspects of Measurement 72**

Multiple Measures 72

Sensitivity and Range Effects 72

Artifacts: Experimenter Bias and Participant Reactivity 73

Selecting a Measurement Procedure 77

**Chapter Summary 78****Key Words 78****Exercises 79****Learning Check Answers 80****CHAPTER 4 Ethics in Research****81****CHAPTER LEARNING OBJECTIVES 81****CHAPTER OVERVIEW 82****4.1 Introduction 83**

Ethical Concerns Throughout the Research Process 83

The Basic Categories of Ethical Responsibility 84

**4.2 Ethical Issues and Human Participants in Research 84**

Historical Highlights of Treatment of Human Participants 84

American Psychological Association Guidelines 87

The Institutional Review Board 97

**4.3 Ethical Issues and Nonhuman Subjects in Research 99**

Historical Highlights of Treatment of Nonhuman Subjects 100

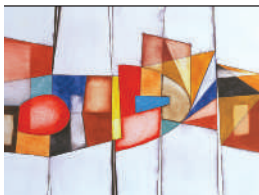
American Psychological Association Guidelines 100

The Institutional Animal Care and Use Committee 101

**4.4 Ethical Issues and Scientific Integrity 102**

Fraud in Science 102

Plagiarism 104

**Chapter Summary 106****Key Words 106****Exercises 107****Learning Check Answers 107****CHAPTER 5 Selecting Research Participants****109****CHAPTER LEARNING OBJECTIVES 109****CHAPTER OVERVIEW 110****5.1 Introduction to Sampling 110**

Populations and Samples 111

Representative Samples 113

Sample Size 113

Sampling Basics 115

- 5.2 Probability Sampling Methods 116**
  - Simple Random Sampling 116
  - Systematic Sampling 118
  - Stratified Random Sampling 118
  - Proportionate Stratified Random Sampling 120
  - Cluster Sampling 120
  - Combined-Strategy Sampling 121
  - A Summary of Probability Sampling Methods 121
- 5.3 Nonprobability Sampling Methods 122**
  - Convenience Sampling 122
  - Quota Sampling 123
  - Chapter Summary 125**
  - Key Words 125**
  - Exercises 126**
  - Learning Check Answers 126**

## CHAPTER 6 Research Strategies and Validity

127



### CHAPTER LEARNING OBJECTIVES 127

### CHAPTER OVERVIEW 128

#### 6.1 Research Strategies 129

- The Descriptive Research Strategy: Examining Individual Variables 130
- Strategies That Examine Relationships between Variables 130
- The Correlational Research Strategy: Measuring Two Variables for Each Individual 131
- Comparing Two or More Sets of Scores: The Experimental, Quasi-Experimental, and Nonexperimental Research Strategies 132
- Nonexperimental and Correlational Research 134
- Research Strategy Summary 135
- Research Strategies, Research Designs, and Research Procedures 136
- Data Structures and Statistical Analysis 137
- Summary 138

#### 6.2 External and Internal Validity 138

- External Validity 139
- Internal Validity 140
- Validity and the Quality of a Research Study 141

#### 6.3 Threats to External Validity 142

- Category 1: Generalizing across Participants or Subjects 142
- Category 2: Generalizing across Features of a Study 144
- Category 3: Generalizing across Features of the Measures 145

- 6.4 Threats to Internal Validity 147**
  - Extraneous Variables 147
  - Confounding Variables 148
  - Extraneous Variables, Confounding Variables, and Internal Validity 148
- 6.5 More about Internal and External Validity 152**
  - Balancing Internal and External Validity 152
  - Artifacts: Threats to Both Internal and External Validity 152
  - Exaggerated Variables 153
  - Validity and Individual Research Strategies 153
  - Chapter Summary 154**
  - Key Words 155**
  - Exercises 155**
  - Learning Check Answers 156**

## CHAPTER 7 The Experimental Research Strategy

157



### CHAPTER LEARNING OBJECTIVES 157

### CHAPTER OVERVIEW 158

- 7.1 Cause-and-Effect Relationships 159**
  - Terminology for the Experimental Research Strategy 160
  - Causation and the Third-Variable Problem 162
  - Causation and the Directionality Problem 162
  - Controlling Nature 163
- 7.2 Distinguishing Elements of an Experiment 164**
  - Manipulation 165
  - Control 167
  - Extraneous Variables and Confounding Variables 168
- 7.3 Controlling Extraneous Variables 170**
  - Control by Holding Constant or Matching 170
  - Control by Randomization 172
  - Comparing Methods of Control 173
  - Advantages and Disadvantages of Control Methods 174
- 7.4 Control Conditions and Manipulation Checks 174**
  - Control Conditions 175
  - Manipulation Checks 177
- 7.5 Increasing External Validity: Simulation and Field Studies 178**
  - Simulation 179
  - Field Studies 180
  - Advantages and Disadvantages of Simulation and Field Studies 180
  - Chapter Summary 181**
  - Key Words 182**
  - Exercises 182**
  - Learning Check Answers 183**

CHAPTER 8 **Experimental Designs: Between-Subjects Design 185**



**CHAPTER LEARNING OBJECTIVES 185**

**CHAPTER OVERVIEW 186**

- 8.1 Introduction to Between-Subjects Experiments 186**
  - Review of the Experimental Research Strategy 187
  - Characteristics of Between-Subjects Designs 187
  - Advantages and Disadvantages of Between-Subjects Designs 189
- 8.2 Individual Differences as Confounding Variables 191**
  - Other Confounding Variables 191
  - Equivalent Groups 192
- 8.3 Limiting Confounding by Individual Differences 193**
  - Random Assignment (Randomization) 193
  - Matching Groups (Matched Assignment) 194
  - Holding Variables Constant or Restricting Range of Variability 195
  - Summary and Recommendations 195
- 8.4 Individual Differences and Variability 196**
  - Differences between Treatments and Variance within Treatments 198
  - Minimizing Variance within Treatments 199
  - Summary and Recommendations 200
- 8.5 Other Threats to Internal Validity of Between-Subjects Experimental Designs 201**
  - Differential Attrition 202
  - Communication between Groups 202
- 8.6 Applications and Statistical Analyses of Between-Subjects Designs 204**
  - Two-Group Mean Difference 204
  - Comparing Means for More Than Two Groups 205
  - Comparing Proportions for Two or More Groups 206
  - Chapter Summary 208
  - Key Words 208
  - Exercises 208
  - Learning Check Answers 209

CHAPTER 9 **Experimental Designs: Within-Subjects Design 211**



**CHAPTER LEARNING OBJECTIVES 211**

**CHAPTER OVERVIEW 212**

- 9.1 Within-Subjects Experiments and Internal Validity 212**
  - Characteristics of Within-Subjects Designs 212
  - Threats to Internal Validity of Within-Subjects Experiments 214

Separating Time-Related Factors and Order Effects	217
Order Effects as a Confounding Variable	217
<b>9.2 Dealing with Time-Related Threats and Order Effects</b>	<b>219</b>
Controlling Time	220
Switch to a Between-Subjects Design	220
Counterbalancing: Matching Treatments with Respect to Time	220
Limitations of Counterbalancing	222
<b>9.3 Comparing Within-Subjects and Between-Subjects Designs</b>	<b>225</b>
Advantages of Within-Subjects Designs	225
Disadvantages of Within-Subjects Designs	229
Choosing Within- or Between-Subjects Design	231
Matched-Subjects Designs	231
<b>9.4 Applications and Statistical Analysis of Within-Subjects Designs</b>	<b>233</b>
Two-Treatment Designs	233
Multiple-Treatment Designs	234
Chapter Summary	235
Key Words	235
Exercises	236
Learning Check Answers	236

## CHAPTER 10 The Nonexperimental and Quasi-Experimental Strategies: Nonequivalent Group, Pre–Post, and Developmental Designs 237



### CHAPTER LEARNING OBJECTIVES 237

### CHAPTER OVERVIEW 238

<b>10.1 Nonexperimental and Quasi-Experimental Research Strategies</b>	<b>239</b>
The Structure of Nonexperimental and Quasi-Experimental Designs	240
<b>10.2 Between-Subjects Nonexperimental and Quasi-Experimental Designs: Nonequivalent Group Designs</b>	<b>242</b>
Threats to Internal Validity for Nonequivalent Group Designs	243
Nonexperimental Designs with Nonequivalent Groups	244
A Quasi-Experimental Design with Nonequivalent Groups	247
<b>10.3 Within-Subjects Nonexperimental and Quasi-Experimental Designs: Pre–Post Designs</b>	<b>249</b>
Threats to Internal Validity for Pre–Post Designs	250
A Nonexperimental Pre–Post Design	250
A Quasi-Experimental Pre–Post Design	251
Single-Case Applications of Time-Series Designs	253

**10.4 Developmental Research Designs 254**

- The Cross-Sectional Developmental Research Design 254
- The Longitudinal Developmental Research Design 257

**10.5 Applications, Statistical Analysis, and Terminology for Nonexperimental, Quasi-Experimental, and Developmental Designs 260**

- Application and Analysis 260
- Terminology in Nonexperimental, Quasi-Experimental, and Developmental Designs 261

Chapter Summary 262

Key Words 263

Exercises 263

Learning Check Answers 264

**CHAPTER 11 Factorial Designs**

**265**



**CHAPTER LEARNING OBJECTIVES 265**

**CHAPTER OVERVIEW 266**

**11.1 Introduction to Factorial Designs 267**

**11.2 Main Effects and Interactions 269**

- Main Effects 270
- The Interaction between Factors 271
- Alternative Views of the Interaction between Factors 272
- Identifying Interactions 274
- Interpreting Main Effects and Interactions 274
- Independence of Main Effects and Interactions 276

**11.3 Types of Factorial Designs and Analysis 277**

- Between-Subjects and Within-Subjects Designs 278
- Experimental and Nonexperimental or Quasi-Experimental Research Strategies 279
- Pretest–Posttest Control Group Designs 281
- Higher-Order Factorial Designs 282
- Statistical Analysis of Factorial Designs 283

**11.4 Applications of Factorial Designs 284**

- Expanding and Replicating a Previous Study 284
- Reducing Variance in Between-Subjects Designs 285
- Evaluating Order Effects in Within-Subjects Designs 286

Chapter Summary 292

Key Words 293

Exercises 293

Learning Check Answers 294

## CHAPTER 12 The Correlational Research Strategy 295



### CHAPTER LEARNING OBJECTIVES 295

### CHAPTER OVERVIEW 296

#### 12.1 An Introduction to Correlational Research 296

Comparing Correlational, Experimental, and Differential Research 297

#### 12.2 The Data and Statistical Analysis for Correlational Studies 298

Evaluating Relationships for Numerical Scores (Interval or Ratio Scales) and Ranks (Ordinal Scale) 299

Evaluating Relationships for Non-Numerical Scores from Nominal Scales 301

Interpreting and Statistically Evaluating a Correlation 303

#### 12.3 Applications of the Correlational Strategy 305

Prediction 305

Reliability and Validity 306

Evaluating Theories 306

#### 12.4 Strengths and Weaknesses of the Correlational Research Strategy 307

Relationships with More Than Two Variables 309

Chapter Summary 311

Key Words 311

Exercises 311

Learning Check Answers 312

## CHAPTER 13 The Descriptive Research Strategy 313



### CHAPTER LEARNING OBJECTIVES 313

### CHAPTER OVERVIEW 314

#### 13.1 An Introduction to Descriptive Research 314

#### 13.2 The Observational Research Design 315

Behavioral Observation 316

Content Analysis and Archival Research 318

Types of Observation and Examples 318

Strengths and Weaknesses of Observational Research Designs 321

#### 13.3 The Survey Research Design 322

Types of Questions 324

Constructing a Survey 327

Selecting Relevant and Representative Individuals 328



Administering a Survey 329  
Strengths and Weaknesses of Survey Research 332

**13.4 The Case Study Design 334**

Applications of the Case Study Design 334  
Strengths and Weaknesses of the Case Study Design 336

Chapter Summary 338

Key Words 338

Exercises 338

Learning Check Answers 339

---

**CHAPTER 14 Single-Case Experimental Research Designs 341**



**CHAPTER LEARNING OBJECTIVES 341**

**CHAPTER OVERVIEW 342**

**14.1 Introduction 343**

Critical Elements of a Single-Case Experimental Design 344  
Evaluating the Results from a Single-Case Study 344

**14.2 Phases and Phase Changes 346**

Level, Trend, and Stability 347  
Changing Phases 350  
Visual Inspection Techniques 351

**14.3 Reversal Designs: ABAB and Variations 355**

Limitations of the ABAB Design 357  
Variations on the ABAB Design: Creating More Complex  
Phase-Change Designs 358

**14.4 Multiple-Baseline Designs 361**

Characteristics of a Multiple-Baseline Design 361  
Component Analysis Designs 364  
Rationale for the Multiple-Baseline Design 365  
Strengths and Weaknesses of the Multiple-Baseline Design 366

**14.5 General Strengths and Weaknesses  
of Single-Case Designs 368**

Advantages of Single-Case Designs 369  
Disadvantages of Single-Case Designs 369

Chapter Summary 371

Key Words 372

Exercises 372

Learning Check Answers 372

## CHAPTER 15 Statistical Evaluation of Data

373



### CHAPTER LEARNING OBJECTIVES 373

### CHAPTER OVERVIEW 374

#### 15.1 The Role of Statistics in the Research Process 374

- Planning Ahead 375
- Statistics Terminology 375

#### 15.2 Descriptive Statistics 377

- Frequency Distributions 377
- Describing Interval and Ratio Data (Numerical Scores) 379
- Describing Non-Numerical Data from Nominal and Ordinal Scales of Measurement 381
- Using Graphs to Compare Groups of Scores 382
- Correlations 384
- Regression 387
- Multiple Regression 388

#### 15.3 Inferential Statistics 389

- Hypothesis Tests 391
- Reporting Results from a Hypothesis Test 395
- Errors in Hypothesis Testing 396
- Factors That Influence the Outcome of a Hypothesis Test 397
- Supplementing Hypothesis Tests with Measures of Effect Size 399

#### 15.4 Finding the Right Statistics for Your Data 403

- Three Data Structures 403
- Scales of Measurement 404
- Category 1: A Single Group of Participants with One Score per Participant 404
- Category 2: A Single Group of Participants with Two Variables Measured for Each Participant 405
- Category 3: Two or More Groups of Scores with Each Score a Measurement of The Same Variable 407

#### 15.5 Special Statistics for Research 412

- The Spearman–Brown Formula 413
- The Kuder–Richardson Formula 20 413
- Cronbach’s Alpha 414
- Cohen’s Kappa 414

#### Chapter Summary 417

#### Key Words 418

#### Exercises 418

#### Learning Check Answers 420

## CHAPTER 16 Writing an APA-Style Research Report

421



### CHAPTER LEARNING OBJECTIVES 421

### CHAPTER OVERVIEW 422

#### 16.1 The Goal of a Research Report 422

#### 16.2 General APA Guidelines for Writing Style and Format 423

Some Elements of Writing Style 423

Guidelines for Typing or Word Processing 427

Manuscript Pages 427

#### 16.3 The Elements of an APA-Style Research Report 428

Title Page 428

Abstract 430

Introduction 431

Method 434

Results 436

Discussion 436

References 439

Tables and Figures 441

Appendix 441

Submitting a Manuscript for Publication 441

Conference Presentations: Papers and Posters 444

#### 16.4 Writing a Research Proposal 445

Why Write a Research Proposal? 445

How to Write a Research Proposal 446

Chapter Summary 447

Key Words 447

Exercises 447

Learning Check Answers 448

## APPENDICES

**A** Random Number Table and Instruction 449

**B** Statistics Demonstrations and Statistical Tables 453

**C** Instructions for Using SPSS 481

**D** Sample APA-Style Research Report Manuscript for Publication 501

Glossary 511

References 525

Name Index 533

Subject Index 535

For years, we have watched students come into the psychology research methods course with a fundamental fear of science. Somewhere, these students seem to have developed the idea that psychology is interesting and fun, but science is tedious and difficult. Many students even resent the fact that they have to take a research methods course: “After all, I want to be a psychologist, not a scientist.”

As the semester progresses, however, most of these students begin to lose their fears, and many of them actually begin to enjoy the course. Much of this change in attitude is based on a realization that science is simply the technique that psychologists use to gather information and to answer questions. As long as the questions are interesting, then the task of answering them should also be interesting.

When people watch a magician do an amazing trick, the common response is to ask, “How was that done?” In the same way, when you learn something interesting about human behavior, you ought to ask, “How do they know that?” The answer is that most of the existing knowledge in the behavioral sciences was gathered using scientific research methods. If you are really curious about human behavior, then you should also be curious about the process of studying human behavior.

This textbook is developed from years of teaching research methods. During that time, we tried various examples or explanations in the classroom and observed student response. Over the years, the course evolved into a less intimidating and more interesting approach that is highly effective in getting students interested in research. Our students have been very helpful in this evolutionary process. Their feedback has directed our progress through the development of the research methods course and the writing of this book. In many respects, they have been our teachers.

## Overview of Text

---

*Research Methods for the Behavioral Sciences, sixth edition*, is intended for an undergraduate Research Methods course in psychology or any of the behavioral sciences. The overall learning objectives of this book include the following:

1. Describe the scientific method and research process
2. Use research databases to locate and obtain psychology articles relevant to a research topic of interest
3. Analyze and evaluate published research
4. Develop an original research question and hypothesis
5. Define measurement validity and reliability, as well as internal and external validity, and identify the various threats to validity
6. Identify ethical issues pertaining to research in psychology
7. Compare and contrast the various research strategies and designs
8. Identify the descriptive and inferential statistical analyses utilized to interpret and evaluate research
9. Compose an APA-style research report or proposal
10. Critically evaluate secondary sources of scientific information

We have organized the text according to the research process, making it appropriate for use in a lecture-only class or a class with a lab component. The text discusses in detail both experimental and nonexperimental research strategies. We use a rather informal writing style that emphasizes discussion and explanation of topics. For each chapter, pedagogical aids include chapter learning objectives, chapter overview, a list of chapter sections, learning objectives at the beginning of each section, Learning Check questions at the end of each section, a running glossary, a chapter summary and a list of Key Words, and a set of end-of-chapter exercises that are identified by learning objectives.

## Organization of Text

---

Overall, the book is organized around the framework of the research process—from start to finish. This step-by-step approach emphasizes the decisions researchers must make at each stage of the process. The chapters of the text have been organized into five sections. Chapters 1 and 2 focus on the earliest considerations in the research process, presenting an overview of the scientific method and including tips for finding a new idea for research and developing a research hypothesis. Chapters 3–6 focus on the preliminary decisions in the research process, and include information on how to measure variables, maintaining ethical responsibility throughout the research process, selecting participants, and choosing a valid research strategy. Chapters 7–9 introduce the experimental research strategy and provide the details of between-subjects and within-subjects experimental designs. Chapters 10–14 present other (nonexperimental) research strategies and their associated research designs, and single-case experimental designs. Chapters 15 and 16 focus on the ending decisions in the research process and include information on how to evaluate, interpret, and communicate the results of the research process.

Although the chapters are organized in a series that we view as appropriate for a one-semester research methods course, the order of chapters can be varied to meet the requirements of different course instructors. For example, the chapters on statistics and APA style can easily be presented much earlier in the course.

## Writing Style

---

We have attempted to use a rather informal, conversational style of writing that emphasizes discussion and explanation of topics rather than a simple “cookbook” presentation of facts. We have found this style to be very successful in our own classes and in our other coauthored textbooks, *Essentials of Statistics for the Behavioral Sciences* and *Statistics for the Behavioral Sciences*. Students find this style very readable and unimposing. This style is particularly useful for material that students perceive as being difficult, including the topic of this text, research methodology.

## Pedagogical Aids

---

One item that has received particular attention as we developed this text is the use of a variety of pedagogical aids. Each chapter includes many opportunities for students to interact with the material, rather than simply be passively exposed to the material. In addition, the Learning Checks, and end-of-chapter exercises may be used by the instructor as prepackaged assignments.

Each chapter contains the following pedagogical elements:

1. *Chapter Learning Objectives*: Each chapter starts with a complete list of learning objectives to assist students in recognizing what they should be able to do by the end of the whole chapter.
2. *Chapter Overview*: Each chapter starts with a brief summary of the contents of the chapter, often in the context of an engaging research example, to prepare and alert students to the material to come.
3. *Chapter Outline*: To help students see the organization of the material in the chapter, a list of the section titles is presented at the beginning of each chapter.
4. *Multiple Sections*: Each chapter is divided into multiple sections and subsections that are clearly defined with headings to help break the material down into smaller, more manageable chunks.
5. *Learning Objectives*: At the beginning of each section, learning objectives are identified to assist students in recognizing what they should be able to do by the end of that section.
6. *Definitions*: Each Key Word used in the text is first bolded. At the end of the paragraph that contains a new Key Word, a clearly identified, concise definition is provided.
7. *Examples*: Numerous examples are used to illustrate concepts presented in the text. Some examples are hypothetical, but most are selected from interesting current or classic studies in psychology.
8. *Boxes*: Boxed material, separate from the regular text, is used to offer additional, interesting information to help demonstrate a point.
9. *Figures*: When appropriate, diagrams or graphs are included to illustrate a point made in the text.
10. *Tables*: Occasionally, tables are used to present information that may best be communicated in a list or to summarize material.
11. *Margin Notes*: Where appropriate, brief notes are presented in the text margins. These notes are used to offer reminders or cautions to the students.
12. *Learning Checks*: At the end of major sections within each chapter, we provide a set of multiple-choice questions to help students test how well they have learned the material in each section. Each Learning Check contains at least one question corresponding to each of the learning objectives for that section. Answers are provided.
13. *Chapter Summaries*: At the end of each chapter, a general summary is presented to help students review the main points of the chapter.
14. *Key Words*: At the end of each chapter, a list of the Key Words used in the chapter is presented. We list the Key Words in their order of appearance in the chapter so that related terms are grouped together and so that students can spot parts of the chapter that they may need to review.
15. *Exercises*: At the end of each chapter are questions and activities for students to answer and apply. Each exercise is identified with a specific learning objective. The intent of the exercises is to help students assess how well they have mastered the objectives by having them apply what they have learned. Additionally, the instructor can use the exercises as assignments. Exercise 1 identifies other important terms that are defined in the Glossary.

## New to This Edition

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Previous edition users should know that we have tried to maintain the hallmark features of our textbook: the organization of the chapters and topics (around the research process), the tone of text (student-friendly, conversational), and the variety of pedagogical aids

(chapter overviews, Learning Objects per section, multiple-choice Learning Checks (for each Learning Objective) per section, end-of-chapter exercises linked to Learning Objectives, bold terms, definitions, interesting research examples, end-of-chapter summaries, keyword lists, etc.).

## Changes Throughout the Book

As with each new edition, we continue to strive to edit each edition to enhance the clarity of material—making changes to wording, organization, trying to be as clear as possible for students to understand.

To reduce some redundancy between the previous edition’s Chapter Previews and Chapter Overviews, these sections have now been combined into the Chapter Overview. The emphasis is on piquing students’ interest, often by discussing an interesting research example, and putting them in the “mind-set” for the material to come in the chapter.

Throughout the book, research examples have been updated, not only to clearly illustrate concepts but also always with an eye toward selecting examples that are of particular interest and relevance to college students.

End-of-chapter Exercises and Engagement Activities have been combined into one Exercises section.

Almost all end-of-section Learning Checks and end-of-chapter exercises have been revised or replaced, always with a minimum of one question per learning objective.

To be more socially inclusionary, we have removed and replaced most bivariate gender examples.

This *Research Methods* book has been modified to have the same “look and feel” as our *Essentials of Statistics* book, enabling a more seamless transition between from statistics to research methods courses.

## Additional Chapter-by-Chapter Revisions

Chapter 1. Deleted Box 1 to reduce size of the chapter. Greatly streamlined the section on the Rational Method. In Step 1 of the research process, more clearly distinguished between a general topic and a specific research idea.

Chapter 2. As in Chapter 1, we increased the distinction between identifying a *general topic/idea* and *finding* a specific research idea/question. Also, like newly done in Chapter 1, distinguishing between hypothesis and predictions and how steps 3 & 4 (Making the study) are needed for the prediction. Sections 2.1 and 2.2 have been reorganized and rewritten to distinguish between part 1, topic, and 2, reviewing literature for idea, by reframed the *necessity* of reviewing the literature—including a new analogy of “joining the research conversation.” A new research example and figure help students to think critically about the primary, empirical journal articles they are reading (with the help of critical thinking column of table also), so that they can extend research and create new research ideas.

Chapter 3. Clarified the concept of an operational definition and its limitations. Simplified the discussion of observer error as a component of measurement. Clarified the distinctions between the different scales of measurement.

Chapter 4. Expanded the description of the three basic principles of the Belmont Report, including examples of violations of each from unethical research, and notes about parallels of these principles with the APA Ethics Code. The sections on ethical guidelines for research with humans and nonhumans were updated in accordance with the APA current 2010 with new 2017 APA ethical standards amendments (section 3.04). Citations and website locations for all updated guidelines throughout the chapter are now included. Added recent, interesting fraud example of Diederick Stapel (with over 30 published papers found to be fraudulent). Added additional safeguard to protect from fraud, that

is, APA Ethics Code requirement of sharing of data, and journals and funding agencies requirement of open access to data.

Chapter 5. Clarified the discussion of simple random sampling and the distinction between sampling with and without replacement.

Chapter 6. We better aligned the three data structures (used to organize the research strategies), with parallel material presented in Chapter 15, Section 4. The term “assignment bias,” which is not commonly indexed, was removed. Instead clarified discussion of participant variables as personal characteristics that differ from one individual to another, and that individual differences are part of any study. Further clarified that if there are consistent differences between groups, on one or more participant variables, then a between-subjects design is confounded by individual differences.

Chapter 7. Updated terminology from *control group* to *control condition*. Simplified and shortened the discussion of simulation and field studies.

Chapter 8. Consistently with revisions made to Chapter 6, removed the term “assignment bias” and instead discussed confounding by individual differences between groups.

Chapter 9. A new introductory section clarifies the distinction between two types of within-subjects experiments: those in which the treatments are administered sequentially over time and those in which the treatments are mixed together in one experimental session.

Chapter 10. Again, more consistent with phrasing for participant variable and individual differences (again, removing reference to assignment bias).

Chapter 11. The same research example was used repeatedly throughout the chapter to illustrate different concepts instead of introducing new examples each time. The concept of a dependent versus an independent relationship between factors was simplified in the discussion of interactions.

Chapter 12. Minor editing for clarity.

Chapter 13. Revised discussion of case studies to emphasize their strength as a means of introducing new therapies or applications rather than serving as negative counterexamples.

Chapter 14. The chapter has been retitled, *Single-Case Experimental Research Designs*, “single-case” more commonly being used by leaders in the field than “single-subject” (Barlow, Nock, & Hersen, 2009; Kazdin, 2016). Also clarified that this chapter is focused on single-case *experimental* designs. Replaced overview research example with an ABAB design, because that is the design discussed first in the chapter. We also reframed the ABAB design as an example of a reversal design. To reduce the complexity and length of chapter, Section 14.5, on less commonly used designs, has been removed with component analysis relocated with multiple baseline designs. Many new single-case experimental designs have been added throughout the chapter.

Chapter 15. Minor editing for clarity.

Chapter 16. Minor editing for clarity. New updated references in Table 16.2.

## MINDTAP For Gravetter and Forzano’s Research Methods for the Behavioral Sciences

MindTap for Research Methods for the Behavioral Sciences, sixth edition, engages and empowers students to produce their best work—consistently. By seamlessly integrating course material with videos, activities, apps, and much more, MindTap creates a unique learning path that fosters increased comprehension and efficiency.

For students:

- MindTap delivers real-world relevance with activities and assignments that help students build critical thinking and analytic skills that will transfer to other courses and their professional lives.



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- Use powerful analytics and reports that provide a snapshot of class progress, time in course, engagement, and completion.
- In addition to the benefits of the platform, MindTap for Research Methods for the Behavioral Sciences:
  - Includes Research Tutor, a project management tool that helps students stay on task with the research proposal assignment that is often included in the behavioral sciences research methods course. Research Tutor breaks the process down into 10 assignable modules that help manage timelines and turn research ideas into well-constructed research proposals, research papers, or presentations. It's the only interactive tool that helps students evaluate and choose an appropriate topic early in the course and stay on task as they move through their study.

## Supplements

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For instructors, we offer the following supplements—all available online.

- **Cognero.** Cengage Learning Testing Powered by Cognero is a flexible, online system that allows you to author, edit, and manage test bank content from multiple Cengage Learning solutions, create multiple test versions in an instant, and deliver tests from your LMS, your classroom, or wherever you want.
- **Instructor's Manual.** The Online Instructor's Manual contains helpful information including chapter outlines, learning objectives, lecture outlines with discussion points, keywords, annotated learning objectives, lecture ideas, Internet resources, and annotations for the end-of-chapter exercises.
- **PowerPoint.** The Online PowerPoints feature lecture outlines and important visuals from the text.

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## To Contact Us

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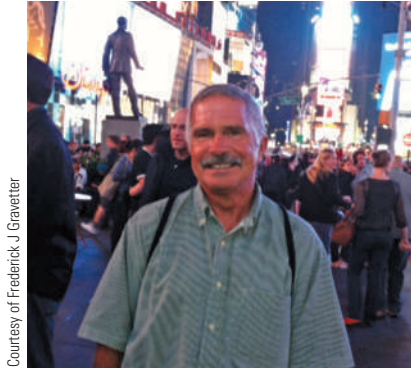
Over the years, our students have given us many helpful suggestions, and we have benefited from their feedback. If you have any suggestions or comments about this book, you can write to us at the Department of Psychology, The College at Brockport, State University of New York, 350 New Campus Drive, Brockport, NY 14420. We can also be reached by e-mail at:

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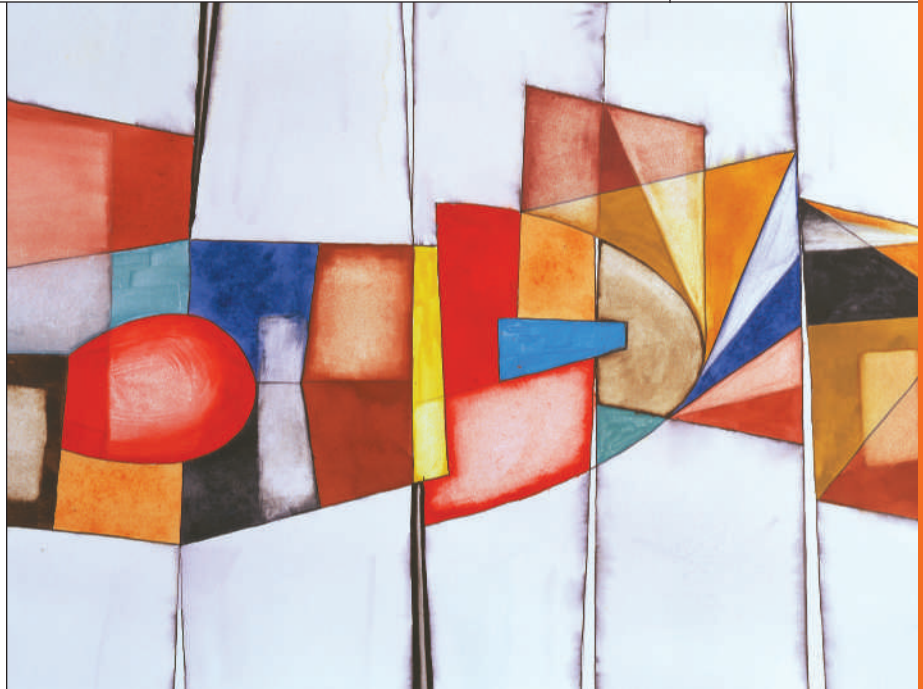


# Introduction, Acquiring Knowledge, and the Scientific Method

**1.1** Methods of Knowing and Acquiring Knowledge

**1.2** The Scientific Method

**1.3** The Research Process



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## CHAPTER LEARNING OBJECTIVES

- LO1** Compare and contrast the nonscientific methods for knowing or acquiring knowledge (tenacity, intuition, authority, the rational method, and the empirical method). Identify an example and explain the limitations of each method.
- LO2** Identify and describe the steps of the scientific method.
- LO3** Define *induction* and *deduction* and explain the role of each in the scientific method.
- LO4** Distinguish between a hypothesis and a prediction.
- LO5** Explain what it means to say that the scientific method is empirical, public, and objective.
- LO6** Distinguish between science and pseudoscience.
- LO7** Distinguish between qualitative and quantitative research and recognize examples of each.
- LO8** Identify and describe the steps in the research process.

## CHAPTER OVERVIEW

In this chapter, we introduce the topic of this textbook: research methodology. Research methods are intended to provide scientists with effective procedures for gathering information and answering questions. We begin by discussing the many ways of acquiring knowledge or finding answers to questions, including the scientific method. Next, we provide a thorough discussion of the scientific method. The chapter ends with an outline of the research process or the way the scientific method is applied to answer a particular question. The research process provides the framework for the rest of the textbook.

### 1.1 Methods of Knowing and Acquiring Knowledge

#### LEARNING OBJECTIVE

**LO1** Compare and contrast the nonscientific methods for knowing or acquiring knowledge (tenacity, intuition, authority, the rational method, and the empirical method). Identify an example and explain the limitations of each method.

Consider the following questions.

Does multitasking make you more efficient with your time?

Does having more friends make you less vulnerable to depression?

Are children of divorced parents less likely to be satisfied with their romantic relationships?

Are girls more likely to cyberbully than boys?

Does eating cake for breakfast make dieters more likely to stick to their diets later in the day?

Are adolescents who play violent video games more aggressive than adolescents who do not play violent video games?

Does playing brain games in adulthood make it less likely you will develop Alzheimer's?

If you find these questions interesting, then you may also be interested in learning how to find the answers. Although there are many different ways to find answers to questions like these, in this book we focus on the method used by behavioral scientists: the scientific method. The scientific method is considered basic, standard practice in the world of science. Students in the behavioral sciences (e.g., psychology, sociology, or criminal justice) should understand how this process works and have some appreciation of its strengths and weaknesses. Before we begin, however, you should realize that the methods used in scientific research are not the only ones available for answering questions, and they are not necessarily the most efficient. There are many different ways of knowing or finding answers to questions. In general, the different ways that people know, or the methods that people use to discover answers, are referred to as **methods of acquiring knowledge**.

Terms printed in boldface are defined in the glossary. Some terms, identified as key words, are also defined in the text.

#### DEFINITION

**Methods of acquiring knowledge** are ways in which a person can know things or discover answers to questions.

The rest of this chapter examines several established methods of knowing and acquiring knowledge. We begin with five nonscientific approaches: the method of tenacity, the method of intuition, the method of authority, the rational method, and the method of empiricism. We conclude with a more detailed discussion of the scientific method. As you will see, the scientific method combines elements from each of the other methods to produce a general question-answering technique that avoids some of the limitations or pitfalls of other methods. Although the scientific method tends to be more complicated and more time consuming than the other methods, the goal is to obtain better-quality answers or at least a higher level of confidence in the answers. Finally, we warn that the scientific method outlines a general strategy for answering questions; the specific details of applying the scientific method to particular problems form the content of the remainder of the book.

### The Method of Tenacity

The **method of tenacity** involves holding on to ideas and beliefs simply because they have been accepted as facts for a long time or because of superstition. Therefore, the method of tenacity is based on habit or superstition. Habit leads us to continue believing something we have always believed. Often this is referred to as belief perseverance. For example, you've probably heard the clichés, "You cannot teach an old dog new tricks" and "Opposites attract." These statements have been presented over and over again, and they have been accepted as true. In general, the more frequently we are exposed to statements, the more we tend to believe them. Advertisers successfully use the method of tenacity, repeating their slogans over and over, hoping consumers will accept them as true (and subsequently buy their products). A very catchy fast-food jingle exclaiming, "I'm lovin' it" hopes we do just that and buy more burgers from them.

#### DEFINITION

In the **method of tenacity**, information is accepted as true because it has always been believed or because superstition supports it.

The method of tenacity also involves the persistence of superstitions, which represent beliefs reacted to as fact. For example, everyone "knows" that breaking a mirror will result in 7 years of bad luck and that you should never walk under a ladder or let a black cat cross your path. Many sports figures will only play a game when wearing their lucky socks or jersey, and many students will not take an exam without their lucky pencil or hat.

One problem with the method of tenacity is that the information acquired might not be accurate. With regard to the statement about old dogs not being able to learn new tricks, the elderly can and do learn (O'Hara, Brooks, Friedman, Schroder, Morgan, & Kraemer, 2007). With regard to the statement that opposites attract, research shows that people are attracted to people who are like them (Klohnen & Luo, 2003). Another pitfall of the method of tenacity is that there is no method for correcting erroneous ideas. Even in the face of evidence to the contrary, a belief that is widely accepted can be very difficult to change.

### The Method of Intuition

In the **method of intuition**, information is accepted as true because it "feels right." With intuition, a person relies on hunches and "instinct" to answer questions. Whenever we say we know something because we have a "gut feeling" about it, we are using the method of intuition. For many questions, this method is the quickest way to obtain answers. When we



have no information at all and cannot refer to supporting data or use rational justification, we often resort to intuition. For example, intuition provides answers when we are making personal choices such as: What should I have for dinner? Should I go out tonight or stay in? The ultimate decision is often determined by what I “feel like” doing. Many ethical decisions or moral questions are resolved by the method of intuition. For example, we know that it is wrong to do something because it does not “feel” right. Parents often advise their children to “trust your instincts.” Part of intuition is probably based on the subtle cues that we pick up from the people around us. Although we can’t explain exactly how we know that a friend is having a bad day, something about the way she moves or speaks tells us that it is true. The predictions and descriptions given by psychics are thought to be intuitive. The problem with the method of intuition is that it has no mechanism for separating accurate from inaccurate knowledge.

**DEFINITION**

In the **method of intuition**, information is accepted on the basis of a hunch or “gut feeling.”

### The Method of Authority

In the **method of authority**, a person finds answers by seeking out an authority on the subject. This can mean consulting an expert directly or going to a library or a website to read the works of an expert. In either case, you are relying on the assumed expertise of another person. Whenever you “google it” or consult books, people, television, or the Internet to find answers, you use the method of authority. Some examples of experts are physicians, scientists, psychologists, professors, stockbrokers, and lawyers.

**DEFINITION**

In the **method of authority**, a person relies on information or answers from an expert in the subject area.

For many questions, the method of authority is an excellent starting point; often, it is the quickest and easiest way to obtain answers. Much of your formal education is based on the notion that answers can be obtained from experts (teachers and textbooks). However, the method of authority has some pitfalls. It does not always provide accurate information. For example, authorities can be biased. We have all seen examples of conflicting testimony by “expert witnesses” in criminal trials. Sources are often biased in favor of a particular point of view or orientation. For example, Democrats and Republicans often have very different answers to the same questions.

Another limitation of the method of authority is that the answers obtained from an expert could represent subjective, personal opinion rather than true expert knowledge. For example, one “expert” reviewer gives a movie a rating of “thumbs up,” whereas another expert gives the same movie “thumbs down.”

An additional limitation of this method is that we often assume that expertise in one area can be generalized to other topics. For example, advertisers often use the endorsements of well-known personalities to sell their products. When a famous athlete appears on television telling you what soup is more nutritious, should you assume that being an outstanding football player makes him an expert on nutrition? The advertisers would like you to accept his recommendation on authority. Similarly, when Linus Pauling, a chemist who won the Nobel Prize for his work on the chemical bond, claimed that vitamin C could cure the common cold, many people accepted his word on authority. His claim is still widely believed, even though numerous scientific studies have failed to find such an effect.

Another pitfall of the method of authority is that people often accept an expert's statement without question. This acceptance can mean that people do not check the accuracy of their sources or even consider looking for a second opinion. As a result, false information is sometimes taken as truth. In some situations, the authority is accepted without question because the information appears to make sense, so there is no obvious reason to question it. We would all like to believe it when the doctor says, "That mole doesn't look cancerous," but you might be better protected by getting a second opinion.

People sometimes accept the word of an authority because they have complete trust in the authority figure. In this situation, the method of authority is often called the **method of faith** because people accept on faith any information that is given. For instance, young children tend to have absolute faith in the answers they get from their parents. Another example of faith exists within religions. A religion typically has a sacred text and/or individuals (pastors, imams, priests, and rabbis) who present answers that are considered the final word. The problem with the method of faith is that it allows no mechanism to test the accuracy of the information. The method of faith involves accepting another's view of the truth without verification.

### DEFINITION

The **method of faith** is a variant of the method of authority in which people have unquestioning trust in the authority figure and, therefore, accept information from the authority without doubt or challenge.

As a final pitfall of the method of authority, realize that not all "experts" are experts. There are a lot of supposed "experts" out there. Turn on the television to any daytime talk show. During the first 45 minutes of the show, in front of millions of viewers, people haggle with one another: Women complain about their husbands, estranged parents and teenagers reunite, or two women fight over the same boyfriend. Then, in the final 15 minutes, the "expert" comes out to discuss the situations and everyone's feelings. These "experts" are often people who lack the credentials, the experience, or the training to make the claims they are making. Being called an expert does not make someone an expert.

In conclusion, we should point out that there are ways to increase confidence in the information you obtain by the method of authority. First, you can evaluate the source of the information. Is the authority really an expert, and is the information really within the authority's area of expertise? Also, is the information an objective fact, or is it simply a subjective opinion? Second, you can evaluate the information itself. Does the information seem reasonable? Does it agree with other information that you already know? If you have any reason to doubt the information obtained from an authority, the best move is to get a second opinion. If two independent authorities provide the same answer, you can be more confident that the answer is correct. For example, when you obtain information from an Internet site, you should be cautious about accepting the information at face value. Do you have previous experience with the site? Is it known to be reputable? If there is any doubt, it pays to check to see that other sites are providing the same information.

The methods of tenacity, intuition, and authority are satisfactory for answering some questions, especially if you need an answer quickly and there are no serious consequences for accepting a wrong answer. For example, these techniques are usually fine for answering questions about which shoes to wear or what vegetable to have with dinner. However, it should be clear that there are situations for which these uncritical techniques are not going to be sufficient. In particular, if the question concerns a major financial decision or if the answer could significantly change your life, you should not accept information as true unless it passes some critical test or meets some minimum standard of accuracy. The next two methods of acquiring knowledge (and the scientific method) are designed to place more demands on the information and answers they produce.

## The Rational Method

The **rational method**, also known as **rationalism**, involves seeking answers by logical reasoning. We begin with a set of known facts or assumptions and use logic to reach a conclusion or get an answer to a question. Suppose a clinical psychologist wants to know whether a client, Amy, is afraid of dogs. A simple example of reasoning that might be used is as follows:

Having a frightening experience with a dog causes fear of dogs in the future.

Amy has a fear of dogs.

Therefore, Amy had a frightening experience with a dog in her past.

In this **argument**, the first two sentences are **premise statements**. That is, they are facts or assumptions that are known (or assumed) to be true. The final sentence is a logical conclusion based on the premises. If the premise statements are, in fact, true and the logic is sound, then the conclusion is guaranteed to be correct. Thus, the answers obtained by the rational method must satisfy the standards established by the rules of logic before they are accepted as true.

Notice that the rational method begins after the premise statements have been presented. In the previous argument, for example, we are not trying to determine whether being frightened by a dog causes fear of dogs; we simply accept this statement as true. Similarly, we are not concerned with proving that Amy is afraid of dogs; we also accept this statement as a fact. Specifically, the rational method does not involve running around making observations and gathering information. Instead, you should think of the rational method as sitting alone, quietly in the dark, mentally manipulating premise statements to determine whether they can be combined to produce a logical conclusion.

### DEFINITIONS

The **rational method**, or **rationalism**, seeks answers by the use of logical reasoning.

In logical reasoning, **premise statements** describe facts or assumptions that are presumed to be true.

An **argument** is a set of premise statements that are logically combined to yield a conclusion.

The preceding example (Amy and the dogs) demonstrates the rational method for answering questions, and it also demonstrates some of the limitations of the rational method. One specific limitation is that the conclusion is not necessarily true unless both of the premise statements are true, even in a valid logical argument. One obvious problem comes from the universal assumption expressed in the first premise statement, “Having a frightening experience with a dog causes fear of dogs in the future.” Although this statement might be accurate for many people who have had a bad experience, there is good reason to doubt that it is absolutely true for all people. In general, the truth of any logical conclusion is founded on the truth of the premise statements. If any basic assumption or premise is incorrect, then we cannot have any confidence in the truth of the logical conclusion.

Another limitation of the rational method is that people are not particularly good at logical reasoning. Many people view the argument about Amy and her fear of dogs as an example of sound reasoning. However, it is not a valid argument; specifically, the conclusion is not logically justified by the premise statements. In case you are not convinced that the argument is invalid, consider the following argument, which has exactly the same

structure but replaces frightening experiences and fear of dogs with violent contact and concussions:

Violent, head-to-head contact in football games causes concussions.

John has a concussion.

Therefore, John experienced violent, head-to-head contact in a football game.

In this case, it should be clear that the argument is not valid; specifically, the conclusion is not justified by the premise statements. Just because John has a concussion, you cannot conclude that it occurred in a football game. Similarly, you cannot conclude that Amy's fear of dogs was caused by a bad experience with a dog. The simple fact that most people have difficulty judging the validity of a logical argument means they can easily make mistakes using the rational method. Unless the logic is sound, the conclusion might not be correct.

A common application of the rational method occurs when people try to think through a problem before they try out different solutions. Suppose, for example, that you have an exam scheduled, but when you are ready to leave for campus, you discover that your car will not start. One response to this situation is to consider your options logically:

1. You could call American Automobile Association (AAA), but by the time they arrive and fix the car, you probably will have missed the exam.
2. You could take the bus, but you do not have the schedule, so you are not sure if the bus can get you to campus on time.
3. You could ask your neighbor to loan you her car for a few hours.

Notice that instead of actually doing something, you are considering possibilities and consequences to find a logical solution to the problem.

In summary, the rational method is the practice of employing reason as a source of knowledge. Answers obtained using the rational method are not simply accepted as true without verification. Instead, all conclusions are tested by ensuring that they conform to the rules of logic. Because the rational method does not involve directly observing or actively gathering information, it has been said that logic is a way of establishing truth in the absence of evidence. As you will see in Section 1.2, the rational method is a critical component of the scientific method. In the next section, we examine the opposite approach, in which we rely entirely on direct observation to obtain evidence to establish the truth.

## The Empirical Method

The **empirical method**, also known as **empiricism**, attempts to answer questions by direct observation or personal experience. This method is a product of the empirical viewpoint in philosophy, which holds that all knowledge is acquired through the senses. Note that when we make observations, we use the senses of seeing, hearing, tasting, and so on.

### DEFINITION

The **empirical method**, or **empiricism**, uses observation or direct sensory experience to obtain knowledge.

Most of you know, for example, that children tend to be shorter than adults, that it is typically warmer in the summer than in the winter, and that a pound of steak costs more than a pound of hamburger. You know these facts from personal experience and from observations you have made.

Many facts or answers are available simply by observing the world around you: That is, you can use the empirical method. For example, you can check the oil level in your car

by simply looking at the dipstick. You could find out the weight of each student in your class just by having each person step on a scale. In many instances, the empirical method provides an easy, direct way to answer questions. However, this method of inquiry also has some limitations.

It is tempting to place great confidence in our own observations. Everyday expressions, such as “I will believe it when I see it with my own eyes,” reveal the faith we place in our own experience. However, we cannot necessarily believe everything we see, or hear and feel. Actually, it is fairly common for people to misperceive or misinterpret the world around them. Figure 1.1 illustrates this point with the horizontal-vertical illusion. Most people perceive the vertical line to be longer than the horizontal line. Actually, they are exactly the same length. (You might want to measure them to convince yourself.) This illustration is a classic example of how direct sensory experience can deceive us.

Although direct experience seems to be a simple way to obtain answers, your perceptions can be drastically altered by prior knowledge, expectations, feelings, or beliefs. As a result, two observers can witness exactly the same event and yet “see” two completely different things. For most students, the following example provides a convincing demonstration that sensory experience can be changed by knowledge or beliefs.

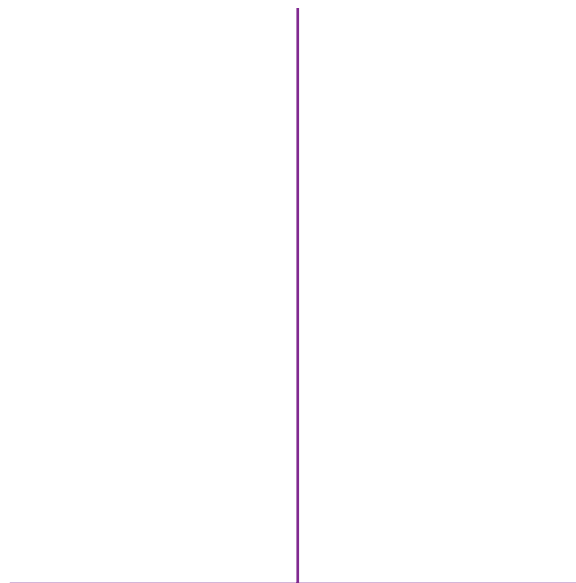
Suppose you are presented with two plates of snack food, and you are asked to sample each and then state your preference. One plate contains regular potato chips and the second contains crispy, brown noodles that taste delicious. Based simply on your experience (taste), you have a strong preference for the noodles. Now suppose that you are told that the “noodles” are actually fried worms. Would you still prefer them to the chips? The problem here is that your sensory experience of good taste (the method of empiricism) is in conflict with your long-held beliefs that people do not eat worms (method of tenacity).

It also is possible to make accurate observations but then misinterpret what you see. For years, people watched the day-to-day cycle of the sun rising in the east and setting in the west. These observations led to the obvious conclusion that the sun must travel in a

### FIGURE 1.1

#### The Horizontal-Vertical Illusion

To most people, the vertical line appears to be longer, even though both lines are exactly the same length.



**TABLE 1.1**  
**Summary of Nonscientific Methods of Acquiring Knowledge**

Method	Way of Knowing or Finding Answer
Tenacity	From habit or superstition
Intuition	From a hunch or feeling
Authority	From an expert
Rationalism	From reasoning; a logical conclusion
Empiricism	From direct sensory observation

huge circle around the earth. Even today, people still speak of the sun “rising” instead of saying that the earth is turning toward the sun.

Finally, the empirical method is usually time consuming and sometimes dangerous. When faced with a problem, for example, you could use the empirical method to try several possible solutions, or you could use the rational method and simply think about each possibility and how it might work. Often, it is faster and easier to think through a problem than to jump in with a trial-and-error approach. Also, it might be safer to use the rational method or the method of authority rather than experience something for yourself. For example, if I wanted to determine whether the mushrooms in my backyard are safe or poisonous, I would rather ask an expert than try the empirical method.

In summary, the empirical method is the practice of employing direct observation as a source of knowledge. In the empirical method, evidence or observations with one’s senses are required for verification of information. Note that the observations can be casual and unplanned, such as when you are simply aware of the world around you. At the other end of the continuum, observations can be systematic and purposeful. As you will see in the next section, the planned and systematic application of the empirical method is a critical component of the scientific method.

### Summary

As you have seen so far, the scientific method is not the only way to know the answers or find the answers to questions. The methods of tenacity, intuition, authority, rationalism, and empiricism are different ways of acquiring knowledge. Table 1.1 provides a summary of these five methods. We should point out that different people can use different methods to answer the same question and can arrive at different, or sometimes the same, answers. For example, if you wanted to know the weight of one of your classmates, you might have her step on a scale (empirical method), simply ask how much she weighs (method of authority), or compare her physical size to your own and calculate an estimated weight relative to how much you weigh (rational method).

### LEARNING CHECK

- Which method of knowing is being used by a student who believes that his performance on tests is influenced by wearing a lucky hat?
  - The method of empiricism
  - The method of faith
  - The method of tenacity
  - The method of authority