GLOBAL EDITION

Applied Behavior Analysis

THIRD EDITION

John O. Cooper • Timothy E. Heron • William L. Heward

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John O. Cooper

Timothy E. Heron

William L. Heward

All, The Ohio State University

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This book is dedicated to Jack Michael, whose extraordinary contributions to behavior analysis will continue to benefit those who teach and practice the science and, most importantly, those whose learning is enhanced by its application.

Photo credit: Amber Hutson.

Jack L. Michael

"One might ask why it is of any value to be able to recognize and correctly name these various effects. I would answer that I have found, for myself at least, that I cannot understand some things unless I can talk about them clearly."[*]

[*]From "What Every Student of Behavior Analysis Ought to Learn: A System for Classifying the Multiple Effects of Behavioral Variables," by J. Michael, 1995, *The Behavior Analyst, 18*, p. 284.

ABOUT THE AUTHORS

Photo credit: Jill C. Dardig.

Tim Heron (left), John Cooper (center), and Bill Heward (right)

John Cooper, Tim Heron, and Bill Heward were faculty members at The Ohio State University for a combined 90 years. Together they trained special education classroom teachers and leadership personnel guided by the philosophical, scientific, and technological principles of applied behavior analysis. The Ph.D. program in special education and applied behavior analysis that they and their colleagues developed at OSU was the first doctoral program accredited by the Association for Behavior Analysis International. John, Tim, and Bill each received the Alumni Award for Distinguished Teaching, OSU's highest honor for teaching excellence. They are joint recipients of the Ellen P. Reese Award for Communication of Behavioral Concepts from the Cambridge Center for Behavioral Studies.

John O. Cooper, Ed.D., is Professor Emeritus in the College of Education and Human Ecology at The Ohio State University. His research and teaching interests include precision teaching, inner behavior, fluency building, and verbal behavior. He is a past president of the Standard Celeration Society, past member of the Board of Directors for the Society for the Advancement of Behavior Analysis, and Applied Representative to the Executive Council and as Chairperson, Graduate Program Accreditation Committee of the Association for Behavior Analysis International.

Timothy E. Heron, Ed.D., is Professor Emeritus in the College of Education and Human Ecology at The Ohio State University. Tim's research interests include tutoring systems, inclusion of students with disabilities in general education classrooms, consultation, and self-correction instructional approaches. Tim is co-author of *The Educational Consultant: Helping Professionals, Parents, and Students in Inclusive Classrooms*, Fourth Edition (with Kathleen Harris, 2001). Since 2000, Tim has been an active Federal Aviation Administration, Gold Seal Certified Flight Instructor; has authored the text *Instrument Flying: 10 Indispensable Principles to Know and Remember*; and continues to apply the principles and procedures of applied behavior analysis to the next generation of aviators.

William L. Heward, Ed.D., BCBA-D, is Professor Emeritus in the College of Education and Human Ecology at The Ohio State University. Bill's interests include "low-tech" methods for increasing the effectiveness of group instruction and promoting the generalization and maintenance of newly learned skills. He has authored or co-authored five other books, including *Exceptional Children: An Introduction to Special Education,* Eleventh Edition (with Sheila Alber-Morgan and Moira Konrad, 2017), and *Sign Here: A Contracting Book for Children and Their Parents* (with Jill C. Dardig, 2016). A Fellow and Past President of the Association for Behavior Analysis International, Bill is a recipient of the Fred S. Keller Behavioral Education Award from Division 25 of the American Psychological Association and the Distinguished Psychology Department Alumnus Award from Western Michigan University.

CHAPTER CONTRIBUTORS

Thomas S. Critchfield, Ph.D., is Professor of Psychology at Illinois State University. He earned his doctorate in Behavior Analysis from West Virginia University and completed a post-doctoral fellowship at the Johns Hopkins University School of Medicine. A Fellow and Past President of the Association for Behavior Analysis International and of Division 25 of the American Psychological Association, Tom has served as Associate Editor for the *Journal of the Experimental Analysis of Behavior*, *Perspectives on Behavior Science, Mexican Journal of Behavior Analysis,* and *Conch Republic Archives of Psychology.* His interests include derived stimulus relations, punishment and negative reinforcement, effective instruction, and the process of bench-to-bedside scientific translation.

Thomas R. Freeman, M.S., BCBA, is Senior Vice President of ABA Technologies, Inc., where he focuses on the dissemination of behavioral science, in part by helping create curricula and instructional materials for the Florida Institute of Technology ABA Online program. With nearly 40 years of experience in ABA, Tom has held various clinical, supervisory, and administrative positions in Massachusetts and Florida. He has also participated in animal behavior studies with orangutans in Borneo and Hawaiian spinner dolphins, and was Field Director of the University of Hawaii's Humpback Whale Project. Tom is dedicated to applying behavior analysis to mainstream social needs (e.g., general education, environmental issues) and common individual challenges (e.g., anxiety, depression, and grief), and is particularly interested in coordinating ABA and psychiatric services, identifying practices as evidence-based (or not), and studying the evolution of ethics.

Brian A. Iwata, Ph.D., is Distinguished Professor of Psychology and Psychiatry at the University of Florida. He and his students have published over 250 articles and chapters on disorders of learning and behavior and on functional analysis methodology. Brian is a former editor of the *Journal of Applied Behavior Analysis* and past president of the Association for Behavior Analysis International, Division 33 of the American Psychological Association, the Society for the Advancement of Behavior Analysis, the Society for the Experimental Analysis of Behavior, and the Florida Association for Behavior Analysis. He has chaired study sections for both NIH and NIMH and is a fellow of the American Association on Intellectual and Developmental Disabilities, the American Psychological Association, the Association for Behavior Analysis International, and the Association for Psychological Scien ce. In 2015, he received the Gold Medal for Lifetime Achievement in the Application of Psychology from the American Psychological Association.

Linda A. LeBlanc, Ph.D., BCBA-D, Licensed Psychologist, is President of LeBlanc Behavioral Consulting. She received her Ph.D. in 1996 from Louisiana State University. She previously taught at Claremont McKenna College, Western Michigan University, and Auburn University, and was Executive Director of Trumpet Behavioral Health. Her research interests focus on behavioral treatment of autism, technology-based behavioral interventions, behavioral gerontology, supervision and mentorship, and systems development in human services. Dr. LeBlanc has been an associate editor for *Behavior Analysis in Practice, The Analysis of Verbal Behavior,* and the *Journal of Applied Behavior Analysis.* She has been a senior editor for *Education and Treatment of Children* and will serve as the editor of the *Journal of Applied Behavior Analysis* from 2020 to 2022. Linda is the 2016 recipient of the American Psychological Association Nathan H. Azrin Award for Distinguished Contribution in Applied Behavior Analysis, and a fellow of the Association of Behavior Analysis International.

Jose Martinez-Diaz, Ph.D., BCBA-D, is Professor and Director of the School of Behavior Analysis at the Florida Institute of Technology, and CEO of ABA Technologies, Inc., an instructional design and technology company. He earned his doctorate in clinical psychology with an emphasis in behavior analysis and therapy from West Virginia University. Jose's principal areas of interest are practitioner training, professional and ethical issues, instructional design and technology, organizational behavior management, and the conceptual analysis of behavior. A past president of the Florida Association of Behavior Analysis (FABA), Jose has served on the board of directors for the Behavior Analyst Certification Board, the Association of Professional Behavior Analysts (APBA), and the Cambridge Center for Behavioral Studies. Awards recognizing Jose's contributions to effective and ethical practice of behavior analysis include the APBA's Jerry Shook Award and FABA's Charles H. Cox Award for Outstanding Service and Advancement of Behavior Analysis in Florida.

Jack Michael, Ph.D., is Professor Emeritus in the Department of Psychology at Western Michigan University, where he taught for 36 years. His primary scholarly interests are verbal behavior, basic theory regarding motivation, and the technical terminology of behavior analysis. Jack contributed to the founding of the Association for Behavior Analysis International and served as its third president. His publications include the highly acclaimed text *Concepts and Principles of Behavior Analysis* (2004). A Fellow of the Association for Behavior Analysis International and the American Psychological Association, Dr. Michael has received many honors and recognitions, including the Distinguished Service to Behavior Analysis Award from the Association for Behavior Analysis, the 2002 Don Hake Award for Translational Research from Division 25 of the American Psychological Association, the 2012 Victor Laties Lifetime of Service Award from the Society for the Experimental Analysis of Behavior, and Western Michigan University's top two faculty honors: Distinguished Faculty Scholar Award and Distinguished Teaching Award. In 2012, Jack was the first recipient of an award named in his honor by the Verbal Behavior Special Interest Group affiliated with ABAI.

Caio F. Miguel, Ph.D., BCBA-D, is Professor of Psychology at California State University, Sacramento. His research interests span basic, applied, and conceptual issues in the study of motivation, verbal behavior, covert mediation, and derived stimulus relations. Caio has served as editor of *The Analysis of Verbal Behavior* and associate editor for the *Journal of Applied Behavior Analysis*. His publications have appeared in English, Portuguese, and Spanish language journals, and he has given hundreds of professional presentations throughout North America, South America, and Europe. Caio received the 2013–2014 Award for Outstanding Scholarly Work from the College of Social Sciences and Interdisciplinary Studies at CSU Sacramento, and the 2014 Outstanding Mentor Award by the Student Committee of the Association for Behavior Analysis International.

Nancy A. Neef, Ph.D., is Professor Emeritus in the College of Education and Human Ecology at The Ohio State University. She has served as editor of the *Journal of Applied Behavior Analysis,* as president of the Society for the Experimental Analysis of Behavior*,* and on the Executive Council and as chair of the publication board for the Association of Behavior Analysis International. Nancy has published more than 60 articles and chapters in the areas of developmental disabilities, research methodology, and instructional technology. Much of her research has focused on extensions and applications of basic research in the assessment and treatment of attention-deficit hyperactivity disorder. Nancy was the recipient of the first Distinguished Alumnus Achievement Award in Psychology from Western Michigan University and the 2006 Award for Outstanding Research in Applied Behavior Analysis from Division 25 of the American Psychological Association.

Stephanie M. Peterson, Ph.D., BCBA-D, is Professor and Chair of the Department of Psychology at Western Michigan University. Her primary research interests are choice and concurrent schedules of reinforcement in the treatment of severe problem behavior and in the functional analysis of problem behavior. Stephanie also has interests in applications of behavior analysis to educational interventions and teacher training. She has served on the editorial boards of the *Journal of Applied Behavior Analysis* and *The Behavior Analyst* and currently serves as a consulting senior editor for *Education and Treatment of Children*. She is a former member of the Board of Directors for the Behavior Analyst Certification Board.

Carol Pilgrim, Ph.D., is Professor of Psychology at the University of North Carolina, Wilmington. Her primary research interests are in the analysis, application, and conceptual treatment of relational stimulus control, particularly stimulus equivalence. Carol is a former editor of *The Behavior Analyst* and associate editor of the *Journal of the Experimental Analysis of Behavior* and *The Behavior Analyst.* She has served as President of the Association for Behavior Analysis International (ABAI), the Society for the Advancement of Behavior Analysis, Division 25 of the American Psychological Association (APA), and the Southeastern Association for Behavior Analysis. Carol is a fellow of ABAI and Division 25 of APA, and she has been honored with the North Carolina Board of Governors Teaching Excellence Award (2003), the UNCW Faculty Scholarship Award (2000) and Graduate Mentor Award (2008), and the ABAI Student Committee Outstanding Mentor Award (2006) and Distinguished Service to Behavior Analysis Award (2017).

Ruth Anne Rehfeldt, Ph.D., BCBA-D, is Professor of Behavior Analysis and Therapy at Southern Illinois University. She completed her Ph.D. at the University of Nevada. Dr. Rehfeldt has published over 100 articles and book chapters in behavior analysis, primarily on basic and applied investigations of verbal behavior and derived relational responding, relational frame theory, and acceptance and commitment therapy. Ruth Anne served as the editor and business manager for *The Psychological Record* for 12 years. She is or has been an editorial board member for a number of behavior analytic journals, including *Journal of Applied Behavior Analysis, Journal of the Experimental Analysis of Behavior,* and *The Analysis of Verbal Behavior*. She has held a number of leadership positions within the Association for Behavior Analysis International. Dr. Rehfeldt has won a number of teaching and research awards during her tenure at Southern Illinois University.

Richard G. Smith, Ph.D., BCBA-D, LBA-TX, is Associate Professor in the Department of Behavior Analysis at the University of North Texas, where he served as Department Chair for 13 years. Rick received his master's and doctoral degrees at the University of Florida. His primary research interest is in the assessment and treatment of behavior disorders in persons with developmental disabilities, with specific areas of focus in motivational variables and advances in functional analysis procedures. A former associate editor for the *Journal of Applied Behavior Analysis,* Rick's work has been recognized with the American Psychological Association's Division 25 B. F. Skinner Award for Innovative and Important Research by a New Researcher (1997), the Texas Chapter of the American Association on Intellectual and Developmental Disabilities' Research Award (2000), the Texas Association for Behavior Analysis' Career Contributions to Behavior Analysis in Texas Award (2014), and the University of North Texas President's Special Faculty Recognition Award (2017).

Mark L. Sundberg, Ph.D., BCBA-D, is a Licensed Psychologist in private practice. He specializes in language research and the development of language assessment and intervention programs for children and adults with language delays. Mark is founder and past editor of the journal *The Analysis of Verbal Behavior,* a past president of The Northern California Association for Behavior Analysis, and a past chair of the Publication Board of the Association for Behavior Analysis International, and has served on the Board of Directors of the B. F. Skinner Foundation. Mark is the author of *The Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP),* and co-author (with James W. Partington) of the books *Teaching Language to Children with Autism or Other Developmental Disabilities* and the original *Assessment of Basic Language and Learning Skills: The ABLLS.* Mark has received several awards, including the 2001 Distinguished Psychology Department Alumnus Award from Western Michigan University and the 2013 Jack Michael Outstanding Contributions in Verbal Behavior Award from ABAI's Verbal Behavior Special Interest Group.

PREFACE

As it was 17 years ago, when we began writing the previous edition of this book, our overriding goal for the third edition was to produce an accurate, comprehensive, and contemporary description of applied behavior analysis. The result is a text that demands concentrated and serious study.

Despite its size, scope, and in-depth treatment of concepts, principles, procedures, and issues, *Applied Behavior Analysis, Third Edition*, should be viewed as an introductory text for two reasons. First, the reader need not possess any specialized prerequisite knowledge to understand the content. Second, attaining a full understanding of applied behavior analysis requires considerable study and guided experience beyond this text. There is no topic presented within these pages that has not been treated in greater depth elsewhere. Students of applied behavior analysis should build upon what they learn from this book by reading other sources. How much reading is needed to fully grasp and appreciate applied behavior analysis? Don Baer (2005), one of the co-founders of applied behavior analysis, estimated that

> [T]he cost of knowing well the basic principles and paradigms of the theoretical and experimental aspects of behavior analysis would require about 2,000 pages and some laboratory experience. ABA shares the same basic principles with the theoretical and experimental branches of behavior analysis and adds to them an even larger number of secondary principles, strategies, and tactics for making those basic principles work in the real world as they do in the laboratory. ABA also adds a set of principles about ethical and humane practice, prominent among which is the need to be certain, through constant and extensive measurement and experimentation, that the particular case in hand is going well and will continue to go well—because it will change as it progresses. The cost of knowing all that is, I estimate, about 3,000 pages of reading and several years of supervised practical experience. (pp. 27–28)

The field has grown markedly since its formal inception in 1968, so much so that Baer's 3000-page reading assignment might now exceed 4000 pages, or more. We trust that this book's 800-plus pages will contribute to Baer's reading assignment for many future behavior analysts. Specific suggestions for additional readings in applied behavior analysis and in the conceptual and basic research branches of behavior analysis are cited throughout this text.

Again, while our objective is to provide a complete description of the principles and procedures for changing and analyzing socially important behavior, mastery of this book's content represents the beginning, not the end, of one's study of applied behavior analysis. If our efforts as textbook writers and chapter contributors, combined with those of instructors who assign this book, are successful, the dedicated student will come away with a sound repertoire of fundamental knowledge about applied behavior analysis. In turn, this knowledge will serve as the foundation for more advanced study and supervised practica that ultimately will lead to independent efforts to change and understand behavior that are scientifically sound, socially significant, and ethically appropriate.

TERMINOLOGY

Meaningful description of any scientific activity necessitates a standard set of technical terms. Effectively communicating the design, implementation, outcomes, and/or theoretical bases of an applied behavior analysis requires the accurate use of the discipline's terminology. Throughout this text, we have made every effort to define and use behavior analytic terminology in a conceptually systematic and consistent manner. Mastering the specialized vocabulary of applied behavior analysis is an important initial step in embracing the science and participating effectively as a researcher, practitioner, or consumer. We encourage students to study the field's terminology with diligence. Toward that end, the third edition includes a glossary of more than 500 technical terms and concepts.

REFERENCES, EXTRACTS, NOTES, AND GRAPHS

An important function of any introductory text to a scientific discipline is to expose students to the empirical and conceptual literature of that field. This edition contains more than 2700 citations to primary-source publications, including historically important experiments (e.g., the first graph presented by B. F. Skinner in his 1938 book *The Behavior of Organisms*), and classic and contemporary examples of applied behavior analysis research—most of which were published in the field's flagship journal, the *Journal of Applied Behavior Analysis.* We also make extensive use of quotations and extracts from key publications representing the conceptual literature. We have done this not only for the historical and/or technical authority these authors provide, but also because their inclusion increases students' exposure to and appreciation for the field's rich primary-source literature.

The third edition includes more than 150 graphs of data from peer-reviewed research, many of which are accompanied by detailed descriptions of the study's methodology. We have a fourfold purpose for providing many procedures, graphs, and references. First, we want to illustrate behavior analysis principles and procedures with actual applications and real data, not hypothetical examples. Second, reading the procedural descriptions will help students appreciate the high degree of technical precision and control of complex environments that researchers and practitioners must achieve to solve problems and show functional relations between variables. Third, the references provide students whose interests are piqued by the descriptions or graphs with directions to the original studies for more in-depth study. Finally, the graphs provide multiple opportunities for students to develop and refine—through practice and discussion with their instructors, mentors, and fellow students—higher-level visual analysis skills.

THIRD EDITION CONTENT ENHANCEMENTS AND FEATURES

Applied behavior analysis has become more mature and sophisticated since the second edition was published. Although the basic principles of behavior remain unchanged, advances in all three interrelated domains of the science of behavior—theoretical, basic research, and applied research—have improved our understanding of those principles and led to increased effectiveness in developing and applying effective and humane behavior change interventions. These developments are reflected in the more than 1,000 new references to the conceptual, basic, and applied literatures of behavior analysis added to this edition.

Chapters by Outstanding Authors

The third edition includes seven chapters authored by prominent scholars in applied behavior analysis. This group of contributors includes the current and two former editors of the *Journal of Applied Behavior Analysis,* two previous editors of *The Analysis of Verbal Behavior,* and associate editors of the *Journal of the Experimental Analysis of Behavior*. Members of this well-known and prolific group of behavior analysts first reported some of the most significant advances in behavior analysis in publications.

Negative Reinforcement

In Chapter 12, Negative Reinforcement, Rick Smith and Brian Iwata present an authoritative account of this commonly misunderstood and misapplied form of reinforcement. In addition to precisely defining this principle, dispelling misconceptions about it, and illustrating applications across a broad spectrum of cases, Smith and Iwata provide specific guidelines for incorporating negative reinforcement into behavior change interventions.

Motivation

Until recently, motivation, a major topic in psychological theories and everyday explanations of behavior, has been an assumed, but inadequately understood, topic in behavior analysis. Due largely to the work of Jack Michael, behavior analysts now have a much better understanding of motivation and its role within applied behavior analysis. In Chapter 16, Motivating Operations, Jack Michael and Caio Miguel explain how certain antecedent events have dual motivating effects: a behavior-altering effect, which makes certain behaviors more (or less) likely; and a value-altering effect, which makes certain events more (or less) effective as reinforcement.

Verbal Behavior

In Chapter 18, Verbal Behavior, Mark Sundberg contrasts B. F. Skinner's functional analysis of verbal behavior with traditional approaches to language, defines and gives examples of basic types of elementary verbal operants (e.g., mands, tacts, intraverbals), and describes implications and applications for these concepts in designing and implementing language intervention programs.

Equivalence-based Instruction

In Chapter 19, Equivalence-based Instruction, Carol Pilgrim builds upon Sidman's groundbreaking research on stimulus equivalence to explain the conditions in which learners acquire new skills and verbal relations without direct instruction on those skills. Pilgrim defines equivalence-based instruction, describes its key outcomes—class formation, delayed emergence, class expansion and class merger, transfer of function, and contextual control—and shows how lessons can be designed to promote those outcomes.

Nonequivalence Relations

In Chapter 20, Engineering Emergent Learning with Nonequivalence Relations, Tom Critchfield and Ruth Anne Rehfeldt explain how people make sense of and function effectively in a world of arbitrary relations in which stimuli "go together," not because they share physical properties, but rather because social-verbal reinforcement contingencies teach people to relate them in a certain way. Relational frame theory (RFT) and acceptance and commitment therapy (ACT), a therapeutic approach grounded in RFT, are described.

Functional Behavior Assessment

In Chapter 27, Functional Behavior Assessment, Stephanie Peterson and Nancy Neef describe one of the more significant developments in applied behavior analysis. Functional behavior assessment has become a well-established method for discovering the function that a problem behavior serves for a person (e.g., to obtain social attention, to avoid an assigned task, to provide sensory stimulation), information that enables practitioners to design interventions that teach adaptive replacement behaviors that serve the same function.

Ethics

In Chapter 31, Ethical and Professional Responsibilities of Applied Behavior Analysts, Tom Freeman, Linda LeBlanc, and Jose Martinez-Diaz clarify what ethical behavior is, explain why ethical behavior is a necessary part of the applied behavior analyst's repertoire, review ethical codes of conduct for behavior analysts, and describe specific procedures for ensuring and assessing ethical practice. New content regarding client services (e.g., informed consent, conflict of interest) and, importantly, ethical implications of new technologies, social media, and professional networking to support ethical behavior is presented.

TEXT ORGANIZATION AND STRUCTURE

The book's 31 chapters are organized into 13 parts. The two chapters in Part 1 describe some tenets that are fundamental to all scientific endeavors, outline a history of behavior analysis as a natural science approach to understanding behavior, define applied behavior analysis, and describe principles and concepts of that science. Parts 2 and 3 examine the elements necessary for an applied behavior analysis. Part 2 presents considerations, criteria, and procedures for selecting, defining, and measuring *applied behavior.* The five chapters in Part 3 examine the logic

and operation of specific tactics for the experimental *analysis* of behavior–environment relations, and some issues in planning, replicating, and evaluating analyses of behavior.

The seven chapters in Parts 4 through 6 explore the two most significant principles of behavior—reinforcement and punishment; how antecedent events alter one's motivation to respond; and how behavior comes under the discriminative control of environmental conditions. Part 7 is a detailed examination of B. F. Skinner's analysis of verbal behavior and its implications and applications for language development. The five chapters in Part 8 describe how applied behavior analysts use equivalence-based instruction, nonequivalence relations, imitation, modeling, observational learning, shaping, and chaining to develop new skills and patterns of behavior from simple to complex.

Part 9 details how problem behaviors can be decreased with nonpunishment interventions: extinction, differential reinforcement, and antecedent interventions. Part 10 describes functional behavioral assessment, sophisticated methods for determining the purpose that problem behavior serves for a person, and important information that leads to the design of treatments that replace the problem behavior with adaptive alternative behavior serving the same function.

Part 11 describes four special applications of behavior change technology: token economy, contingency contracting, group contingencies, and self-management. Part 12 outlines strategies and tactics for increasing the likelihood that efforts to change behavior yield generalized outcomes: behavior changes that maintain across time, occur in appropriate settings and situations beyond the training setting, and spread to other useful behaviors. The book's final part describes ethical and professional responsibilities of behavior analysts, ethical implications of new technologies, social media, and professional networking.

SUPPLEMENTS AND RESOURCES FOR STUDENTS AND INSTRUCTORS

Instructor's Resource Manual and Test Bank (ISBN 1-292-32464-3)

An Instructor's Resource Manual includes suggestions for learning activities, additional Experiencing Firsthand exercises, supplementary lectures, case study analyses, discussion topics, group activities, additional media resources, and answers to all multiple-choice questions and essay-type questions. The *Test Bank* that accompanies this text contains more multiple-choice and essay-type questions. Some items (lower-level questions) simply ask students to identify or explain concepts and principles they have learned. But many others (higher-level questions) ask students to apply those same concepts and principles to specific classroom situations—that is, to actual student behaviors and teaching strategies.

Powerpoint® Slides (ISBN 1-292-32466-X)

The PowerPoint slides include key concept summarizations, diagrams, and other graphic aids to enhance learning. They are designed to help students understand, organize, and remember core concepts and theories.

Companion Website

Text Content Related to the Behavior Analyst Certification Board® BCBA® & BCABA® Behavior Analyst Task List© Fifth Edition

The Behavior Analyst Certification Board® (BACB®) is a nonprofit corporation established in 1998 to meet professional credentialing needs identified by behavior analysts, governments, and consumers of behavior analysis services. To be certified as a Board Certified Behavior Analyst® (BCBA®) or a Board Certified Assistant Behavior Analyst® (BCaBA®), a person must meet academic-degree, educational, and practical-experience eligibility requirements and then pass a psychometrically sound examination. The BCBA and BCaBA examinations are based on the *BCBA/BCaBA Task List* (5th ed.; BACB, 2017a), which was developed by 16 subject matter experts and subsequently content validated through a survey of more than 6000 BACB certificants (BACB, 2017b). The complete *BCBA/BCaBA Task List* (5th ed.) is available on the companion website (www.pearsonglobaleditions.com).

We have connected the content of this text to the tasks that the BACB determined are necessary to function as an entry-level behavior analyst. A chart identifying which Task List items are covered in each chapter is also provided on the companion website. Due to the complex nature of applied behavior analysis, in which the concepts and principles and their application are interrelated and not easily or effectively presented in a linear fashion, some Task List items are covered in more than one chapter. Students studying for BCBA and BCaBA examinations can look up key words from Task List items in the Subject Index to identify the page numbers where relevant information about each item in the *BCBA/BCaBA Task List* (5th ed.) can be found.

This text presents the basic knowledge that a qualified behavior analyst must possess. Although mastering this content will help you obtain a passing score on the BCBA or BCaBA examinations, two important qualifiers must be recognized. First, the BCBA and BCaBA examinations require knowledge beyond that included in this, or any, single textbook. Therefore, to further prepare for the examinations we encourage students to study original sources, engage in supervised practica, and discuss areas of personal interest with trusted and competent mentors. Second, no matter how accurate, extensive, and current this textbook may be, and no matter how thoroughly a student masters its content, he or she will not be fully qualified to function as a behavior analyst. Successful completion of the required coursework in behavior analysis is but one step in the preparation to become a BCBA or a BCaBA. For the most recent information on the BACB requirements, visit the Behavior Analyst Certification Board's website at www.BACB.com.

Behavior Analyst Certification Board. (2017a). *BCBA/BCaBA task list (5th ed.).* Littleton, CO: Author.

Behavior Analyst Certification Board. (2017b, January). *BACB newsletter.* https://www.bacb.com/wp-content/uploads/170113-newsletter.pdf

Acknowledgments

The third edition of *Applied Behavior Analysis* is the product of the collective and cumulative efforts of many people. Although space limitations prevent us from thanking everyone by name, we would like to acknowledge those who made substantial contributions to the book's content or production during the 3 years we spent revising the text. First and foremost, we are deeply grateful to the authors of the seven contributed chapters: Rick Smith and Brian Iwata (Negative Reinforcement); Jack Michael and Caio Miguel (Motivating Operations); Mark Sundberg (Verbal Behavior); Carol Pilgrim (Equivalence-based Instruction); Tom Critchfield and Ruth Anne Rehfeldt (Engineering Emergent Learning with Nonequivalence Relations); Stephanie Peterson and Nancy Neef (Functional Behavior Assessment); and Tom Freeman, Linda LeBlanc, and Jose Martinez-Diaz (Ethical and Professional Responsibilities of Applied Behavior Analysts). Because of their efforts, third edition readers will be introduced to important topics in applied behavior analysis by scholars whose research has helped to define and develop those areas.

We thank the Behavior Analyst Certification Board (BACB) for allowing us to integrate the Behavior Analyst Certification Board® BCBA/BCaBA Task List (5th ed.) throughout the revised edition of our text. We are especially grateful to Jim Carr, Chief Executive Officer of the Behavior Analyst Certification Board. Jim graciously continued the arrangement with the BACB we first developed with Jerry Shook for the second edition.

In-depth reviews of the second edition by Jan Montgomery (Florida Institute of Technology), Bethany Raiff (Rowan University), Corey Robertson (Florida Institute of Technology), Tina Sidener (Caldwell University), and Carlos A. Zuluaga (Florida Institute of Technology) offered helpful recommendations for improvement that we incorporated into this edition. The third edition is also enhanced by input and assistance from the following colleagues: Bill Ahearn (New England Center for Children), Sheila Alber-Morgan (The Ohio State University), Nikolay Alipov (Russian National Investigation Medical University), Fernando Armendariz (FABA, Inc.), Judah Axe (Simmons College), Vince Carbone (The Carbone Clinic), Sharon Chien (SEEK), Darlene Crone-Todd (Salem University), Alyce Dickinson (Western Michigan University), Anca Dumitrescu (ATCA, Romania), Ronnie Dietrich (Wing Institute), Tim Hackenberg (Reed College), Louis Hagopian (Kennedy Krieger Institute), Rob Holdsambeck (Cambridge Center for Behavioral Studies), Mickey Keenan (Ulster University, Northern Ireland), Tracy Kettering (Bancroft), Jonathan Kimball (private practice, Maine), Moira Konrad (The Ohio State University), Douglas Kostewicz (University of Pittsburgh), Rick Kubina (Penn State University), Ed Morris (University of Kansas), Dave Palmer (Smith College), Robert Ross (Beacon ABA Services), Hank Schlinger (California State University, Los Angeles), Majda Seuss (Association for Behavior Analysis International), and Janet Twyman (Center for Innovations in Learning).

Turning more than 2500 pages of manuscript into the book you are holding required the support and contributions of a talented team of publishing professionals at Pearson. Copy editor Joanne "Bonnie" Boehme's talent in turning rough prose into clear and understandable text is evident on every page. The bumpy spots that remain are our responsibility. Production Editor Clara Bartunek and Content Producer Janelle Rogers worked closely and patiently with us throughout. Ann Castel Davis, our former editor, was instrumental in convincing us to tackle this edition. We are grateful to Ann and to Director and Publisher Kevin Davis, for their long-standing commitment not only to this title but also to publishing books on behavior analysis and evidence-based practices in special education.

Last, but certainly not least, among those we wish to acknowledge for important and continuing contributions to the "White Book" is Keith "Dutch" Van Norman. Dutch designed the creative and captivating covers of the second and third editions. Thanks, Dutch!

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BRIEF CONTENTS

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PART 1

Introduction and Basic Concepts

We believe that prior to learning specific principles and procedures for analyzing and changing behavior, the student of applied behavior analysis should be introduced to the historical and conceptual foundations of the science. Basic knowledge and appreciation of the scientific and philosophical underpinnings of behavior analysis are requisites to a thorough understanding of the discipline's nature, scope, and potential. We also believe a preliminary overview of basic concepts, principles, and terminology makes the in-depth study of behavior analysis to follow more effective. The two chapters in Part 1 support these two beliefs. Chapter 1 describes the scientific, conceptual, and philosophical roots of applied behavior analysis and identifies the discipline's defining dimensions, characteristics, and overall goals. Chapter 2 defines the field's fundamental elements—behavior and the environmental antecedent and consequential events that influence it—and introduces key terms and principles that describe relationships among these elements.

CHAPTER 1

Definition and Characteristics of Applied Behavior Analysis

LEARNING OBJECTIVES

- Describe the basic characteristics and goals of science.
- Explain behavior in accordance with the philosophical assumptions of behavior analysis.
- Explain determinism as it relates to behavior analysis.
- State distinguishing features of mentalistic and environmental explanations of behavior.
- Describe and explain behavior in behavior analytic terms.
- State and describe each of the dimensions of applied behavior analysis.

[S]ince I was a child I always found my biggest reinforcer was something called understanding. I liked to know how things worked. And of all of the things in the world there are to understand, it became clear to me that the most fascinating was what people do. I started with the usual physical science stuff, and it was intriguing to me to understand how radios work, and how electricity works, and how clocks work, etcetera. But when it became clear to me that we could also learn how people work—not just biologically, but behaviorally—I thought that's the best of all. Surely, everyone must agree that that's the most fascinating subject matter. That there could be a science of behavior, of what we do, of who we are? How could you resist that?

—Donald M. Baer in Heward & Wood, (2003, p. 302)

Applied behavior analysis is a science devoted to understanding and improving human behavior. Other disciplines have similar intents. What sets applied behavior analysis apart? The answer lies in its focus, goals, and methods. Applied behavior analysts focus on behaviors of social importance, they intervene with research-based strategies and tactics to improve the targeted behaviors, and they use scientific methods—objective description, measurement, and experimentation—to demonstrate reliable relations between their interventions and the behavioral improvements. In short, applied behavior analysis, or ABA, is a scientific approach for discovering environmental variables that reliably influence socially significant behavior and for developing a technology of behavior change that takes practical advantage of those discoveries.

This chapter briefly outlines the history and development of behavior analysis, discusses the philosophy that underlies the science, and identifies defining dimensions and characteristics of applied behavior analysis. Because applied behavior analysis is first and foremost a science, we begin with an overview of precepts shared by scientists in all disciplines.

SCIENCE: BASIC CHARACTERISTICS AND A DEFINITION

Science is a systematic approach for seeking and organizing knowledge about the natural world. Before offering a definition of science, we discuss the purpose of science and the basic assumptions and attitudes that guide the work of all scientists, irrespective of their fields of study.

Purpose of Science

The overall goal of science is to achieve a thorough understanding of the phenomena under study—socially important behavior change, in the case of applied behavior analysis. Science differs from other sources of knowledge or ways we obtain knowledge about the world around us (e.g., contemplation, common sense, logic, authority figures, religious or spiritual beliefs, political campaigns, advertisements, testimonials). Science seeks to discover nature's truths: facts and universal laws that exist and operate independent of the opinions and beliefs of any person or group, including the scientist. Therefore, scientific knowledge must be separated from any personal, political, economic, or other reasons for which it was sought. Although it is frequently misused, science is not a tool for validating the cherished or preferred versions of "the truth" held by any group, corporation, government, or institution.

Different types of scientific investigations yield knowledge enabling one or more of three levels of understanding: description, prediction, and control. Each level of understanding contributes to the scientific knowledge base of a given field of inquiry.

Description

Systematic observation enhances the understanding of a given phenomenon by enabling scientists to describe it accurately. Descriptive knowledge consists of a collection of facts about the observed events that can be quantified, classified, and examined for possible relations with other known facts—a necessary and important activity for any scientific discipline. The knowledge obtained from descriptive studies often suggests possible hypotheses or questions for additional research.

The work of John James Audubon, a naturalist and painter in the early 19th century, provides a classic example of descriptive science. While observing birds in their natural habitat, Audubon documented their habits with extensive field notes and made detailed drawings. He identified 25 new species of birds. His major work, *The Birds of America* (Audubon, 1827–1838), contains 435 hand-colored life-sized prints of birds in their natural habitat and is considered one of the finest ornithological works ever completed.

White's (1975) study of classroom teachers' "natural rates" of approval (verbal praise or encouragement) and disapproval (criticisms, reproach) is an example of descriptive research in applied behavior analysis. Observations of 104 classroom teachers in grades 1 to 12 yielded two major findings: (a) Rates of teacher praise dropped with each grade level, and (b) in every grade after second, teachers delivered statements of disapproval to students at rates exceeding their rates of praise. The results of this descriptive study led to dozens of subsequent studies aimed at discovering factors responsible for the disappointing findings, analyzing the effects of disproportionate rates of disapproval and praise on student behavior, and increasing teachers' effective use of praise (e.g., Alber, Heward, & Hippler, 1999; Duchaine, Jolivette, & Fredrick, 2011; Fullerton, Conroy, & Correa, 2009; Mrachko, Kostewicz, & Martin, 2017; Niwayama & Tanaka-Matsumi, 2016; Sutherland, Wehby, & Yoder, 2002).

Prediction

A second level of scientific understanding occurs when repeated observations reveal that two events consistently covary with each other. That is, in the presence of one event (e.g., approaching winter) another event occurs (or fails to occur) with some specified probability (e.g., certain birds fly south). When systematic covariation between two events is found, this relationship—termed a *correlation*—can be used to predict the relative probability that one event will occur, based on the presence of the other event. "We obviously cannot intervene or manipulate the movement of the stars or planets, but by studying their movements we can gauge the seasons and when we can plant crops to produce a bountiful harvest" (Moore, 2010, p. 48).

Because no variables are manipulated or controlled by the researcher, a correlational study cannot demonstrate whether one of the observed variables is responsible for the changes in the other variable, and no such relations should be inferred. A strong correlation exists between hot weather and an increased incidence of drowning deaths, but we should not assume that a hot and humid day causes anyone to drown. Hot weather also correlates with other factors, such as an increased number of people (both swimmers and nonswimmers) seeking relief in the water, and many instances of drowning have been found to be a function of factors such as the use of alcohol or drugs, the relative swimming skills of the victims, strong riptides, and the absence of supervision by lifeguards.[1]

In addition to their usefulness in aiding prediction, the findings of correlational studies can suggest the possibility of causal relations, which can then be explored with experimental studies. The most common type of correlational study reported in the applied behavior analysis literature compares the relative rates or conditional probabilities of two or more observed (but not manipulated) variables (e.g., Atwater & Morris, 1988; Symons, Hoch, Dahl, & McComas, 2003; Thompson & Iwata, 2001). For example, McKerchar and Thompson (2004) found correlations between problem behavior exhibited by 14 preschool children and the following consequent events: teacher attention (100% of the children), presentation of some material or item to the child (79% of the children), and escape from instructional tasks (33% of the children). The results of this study not only provide empirical validation for the social consequences typically used in clinical settings to analyze the variables maintaining children's problem behavior, but also increase confidence in the prediction that interventions based on the findings from such assessments will be relevant to the conditions that occur naturally in preschool classrooms (see Chapter 27). In addition, by revealing the high probabilities with which teachers responded to problem behavior in ways that are likely to maintain and strengthen it, McKerchar and Thompson's findings also point to the need to train teachers in more effective ways to respond to problem behavior.

Control

The ability to predict with a certain degree of confidence is a valuable and useful result of science; prediction enables preparation. However, the greatest potential benefits from science are derived from the third, and highest, level of scientific understanding—control. Evidence of the kinds of control that can be derived from scientific findings in the physical and biological sciences surrounds us in the everyday technologies we take for granted: pasteurized milk and the refrigerators we store it in; flu shots and the automobiles we drive to go get them; pain relievers and the televisions that bombard us with advertisements and news stories about the drugs.

> The scientific "system," like the law, is designed to enable us to handle a subject matter more efficiently . . . When we have discovered the laws which govern a part of the world about us, we are then ready to deal effectively with that part of the world. By predicting the occurrence of an event we are able to prepare for it. By arranging conditions in ways specified by the laws of a system, we not only predict, we control: we "cause" an event to occur or to assume certain characteristics. (Skinner, 1953, pp. 13–14)

Functional relations, the primary products of basic and applied research in behavior analysis, provide the kind

of scientific understanding that is most valuable and useful to the development of a technology for changing behavior. A **functional relation** exists when a well-controlled experiment demonstrates that a specific change in one event (the *dependent variable*) is reliably produced by specific manipulations of another event (the *independent variable*), and that the change in the dependent variable was unlikely to be the result of other extraneous factors (*confounding variables*).

Johnston and Pennypacker (1980) described functional relations as "the ultimate product of a natural scientific investigation of the relation between behavior and its determining variables" (p. 16).

> Such a "co-relation" is expressed as $y = f(x)$, where x is the independent variable or argument of the function, and y is the dependent variable. In order to determine if an observed relation is truly functional, it is necessary to demonstrate the operation of the values of x in isolation and show that they are sufficient for the production of y. . . . [H]owever, a more powerful relation exists if necessity can be shown (that y occurs *only if* x occurs). The most complete and elegant form of empirical inquiry involves applying the experimental method to identifying functional relations. (Johnston & Pennypacker, 1993a, p. 239)

The understanding gained by the scientific discovery of functional relations is the basis of applied technologies in all fields.

Assumptions and Attitudes of Science

> *Science is first of all a set of attitudes.*
>
> —B. F. Skinner, (1953, p. 12)

The definition of science lies not in test tubes, spectrometers, or electron accelerators, but in the behavior of scientists. To begin to understand any science, we need to look past the apparatus and instrumentation that are most readily apparent and examine what scientists do.[2] The pursuit of knowledge is properly called *science* when it is carried out according to general methodological precepts and expectations that define science. All scientists share a fundamental assumption about the nature of events that are amenable to investigation by science, general notions about basic strategy, and perspectives on how to view their findings. These attitudes of science—determinism, empiricism, experimentation, replication, parsimony, and philosophic doubt—constitute a set of overriding assumptions and values that guide the work of all scientists (Whaley & Surratt, 1968).

Determinism

Science is predicated on the assumption of **determinism**. All scientists presume that the universe is a lawful and orderly place in which all phenomena occur as the result of other events. In other words, events do not just happen willy-nilly; they are related in systematic ways to other factors, which are themselves physical phenomena amenable to scientific investigation.

If the universe were governed by *accidentalism,* a philosophical position antithetical to determinism that holds that events occur by accident or without cause, or by *fatalism,* the belief that events are predetermined, the scientific discovery of functional relations and use of those discoveries to improve things would be impossible.

> If we are to use the methods of science in the field of human affairs, we must assume behavior is lawful and determined. We must expect to discover what a man does is the result of specifiable conditions and that once these conditions have been discovered, we can anticipate and to some extent determine his actions. (Skinner, 1953, p. 6)

Determinism plays a pivotal dual role in the conduct of scientific practice: It is at once a philosophical stance that does not lend itself to proof and the confirmation that is sought by each experiment. In other words, the scientist first assumes lawfulness and then proceeds to look for lawful relations (Delprato & Midgley, 1992).

Empiricism

> *When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind*
>
> — Lord Kelvin, (1824–1907)

Scientific knowledge is built on, above all, **empiricism**—the practice of objective observation and measurement of the phenomena of interest. Objectivity in this sense means "independent of the individual prejudices, tastes, and private opinions of the scientist. Results of empirical methods are objective in that they are open to anyone's observation and do not depend on the subjective belief of the individual scientist" (Zuriff, 1985, p. 9).

In the prescientific era (and in nonscientific and pseudoscientific activities today) (Nichols, 2017), knowledge was (and is) the product of contemplation, speculation, personal opinion, authority, and the "obvious" logic of common sense. The scientist's empirical attitude, however, demands objective observation based on thorough description, systematic and repeated measurement, and precise quantification of the phenomena of interest.

As it is in every scientific field, empiricism is the foremost rule in behavior analysis. Every effort to understand, predict, and improve behavior hinges on the behavior analyst's ability to completely define, systematically observe, and accurately and reliably measure occurrences and nonoccurrences of the behavior of interest.

Experimentation

Experimentation is the basic strategy of most sciences. Whaley and Surratt (1968) used the following anecdote to introduce the need for experimentation.

> A man who lived in a suburban dwelling area was surprised one evening to see his neighbor bow to the four winds, chant a strange melody, and dance around his front lawn beating a small drum. After witnessing the same ritual for over a month, the man became overwhelmed with curiosity and decided to look into the matter.

> "Why do you go through this same ritual each evening?" the man asked his neighbor.
>
> "It keeps my house safe from tigers," the neighbor replied.
>
> "Good grief!" the man said. "Don't you know there isn't a tiger within a thousand miles of here?"
>
> "Yeah," the neighbor smiled. "Sure works, doesn't it!" (pp. 23–2 to 23–3)

When events are observed to covary or occur in close temporal sequence, a functional relation may exist, but other factors may be responsible for the observed values of the dependent variable. To investigate the possible existence of a functional relation, an experiment (or better, a series of experiments) must be performed in which the factor(s) suspected of having causal status are systematically controlled and manipulated while the effects on the event under study are carefully observed.

Reliably predicting and controlling any phenomena, including the presence of tigers in one's backyard, requires identifying and manipulating the factors that influence those phenomena. One way that the individual described previously could use the experimental method to evaluate the effectiveness of his ritual would be to first move to a neighborhood in which tigers are regularly observed and then systematically manipulate the use of his anti-tiger ritual (e.g., 1 week off, 1 week on, 1 week off, 1 week on) while observing and recording the presence of tigers under the no-ritual and ritual conditions.

> The experimental method is a method for isolating the relevant variables within a pattern of events. . . . [W]hen the experimental method is employed, it is possible to change one factor at a time (independent variable) while leaving all other aspects of the situation the same, and then to observe what effect this change has on the target behavior (dependent variable). Ideally, a functional relation may be obtained. Formal techniques of experimental control are designed to make sure that the conditions being compared are otherwise the same. Use of the experimental method serves as a necessary condition (sine qua non) to distinguish the experimental analysis of behavior from other methods of investigation. (Dinsmoor, 2003, p. 152)

Thus, an **experiment** is a controlled comparison of some measure of the phenomenon of interest (the dependent variable) under two or more different conditions in which only one factor at a time (the independent variable) differs from one condition to another. Strategies and tactics for conducting experiments in applied behavior analysis are described in Chapters 7 through 10.

Most of the studies cited in this text are experiments that have demonstrated or discovered a functional relation between a target behavior and one or more environmental variables. Such studies are said to have achieved a functional analysis. The term **functional analysis** has two meanings in contemporary behavior analysis literature. In its original and most fundamental usage, *functional analysis* denotes demonstrations of functional relations between environmental variables and behavior. Schlinger and Normand (2013) reported that Skinner used the term 36 times in *Science and Human Behavior* and cited this example:

> The external variables of which behavior is a function provide for what may be called a causal or *functional analysis*. We undertake to predict and control the behavior of the individual organism. This is our "dependent variable"—the effect for which we are to find the cause. Our "independent variables"—the causes of behavior—are the external conditions of which behavior is a function. Relations between the two—the "cause-and-effect relationships" in behavior—are the laws of a science. (Skinner, 1953, p. 35, italics added)

Iwata, Dorsey, Slifer, Bauman, and Richman (1982) introduced the second and today most widely recognized usage of *functional analysis* in their groundbreaking article describing an experimental methodology for determining environmental variables and contingencies maintaining problem behavior (see Chapter 27). In its original meaning, functional analysis provides the very foundation for an experimental science of behavior; as a method for assessing the controlling variables for problem behavior, functional analysis informs the design of effective treatments.

Replication

The results of a single experiment—no matter how well it was designed and conducted, no matter how clear and impressive the findings—are never sufficient to earn an accepted place among the scientific knowledge base of any field. Although the data from a single experiment have value in their own right and cannot be discounted, only after an experiment has been replicated a number of times with the same basic pattern of results are scientists convinced of the findings.

Replication—repeating of experiments (as well as repeating independent variable conditions within experiments)—"pervades every nook and cranny of the experimental method" (Johnston & Pennypacker, 1993a, p. 244). Replication is the primary method with which scientists determine the reliability and usefulness of their findings and discover their mistakes (Johnston & Pennypacker, 1980; 1993a; Sidman, 1960). Replication—not the infallibility or inherent honesty of scientists—is the primary reason science is a self-correcting enterprise that ultimately gets it right (Skinner, 1953).

How many times must an experiment be repeated with the same results before the scientific community accepts the findings? There is no required number of replications, but the greater the importance of the findings to theory or practice, the greater the number of replications to be conducted. Chapters 7 through 10 explain the role of replication in behavioral research and describe replication strategies used by applied behavior analysts.

Parsimony

One dictionary definition of *parsimony* is great frugality, and in a special way this connotation accurately describes the behavior of scientists. As an attitude of science, **parsimony** requires

that all simple, logical explanations for the phenomenon under investigation be ruled out, experimentally or conceptually, before more complex or abstract explanations are considered. Parsimonious interpretations help scientists assess and fit new findings within the field's existing knowledge base. A fully parsimonious interpretation consists only of those elements that are necessary and sufficient to explain the phenomenon at hand. The attitude of parsimony is so critical to scientific explanations that it is sometimes referred to as the Law of Parsimony (Whaley & Surratt, 1968), a "law" derived from *Occam's Razor,* credited to William of Occam (c. 1285–1349), who stated: "One should not increase, beyond what is necessary, the number of entities required to explain anything." In other words, given a choice between two competing and compelling explanations for the same phenomenon, one should shave off extraneous variables and choose the simplest explanation, the one that requires the fewest assumptions.

Philosophic Doubt

The attitude of **philosophic doubt** requires the scientist to continually question the truthfulness of what is regarded as fact. Scientific knowledge must always be viewed as tentative. Scientists must be willing to set aside their most cherished beliefs and findings and replace them with the knowledge derived from new discoveries.

Good scientists maintain a healthy level of skepticism. Although being skeptical of others' research may be easy, a more difficult but critical characteristic of scientists is that they remain open to the possibility—as well as look for evidence—that their own findings or interpretations are wrong. "Science is a willingness to accept facts even when they are opposed to wishes" (Skinner, 1953, p. 12). As Oliver Cromwell (1650) stated in another context: "I beseech you . . . think it possible you may be mistaken." For the true scientist, "new findings are not problems; they are opportunities for further investigation and expanded understanding" (Todd & Morris, 1993, p. 1159).

Practitioners should be as skeptical as researchers. The skeptical practitioner not only requires scientific evidence before implementing a new practice, but also evaluates continually its effectiveness once the practice has been implemented. Practitioners must be particularly skeptical of extraordinary claims made for the effectiveness of new theories, therapies, or treatments (Foxx & Mulick, 2016; Maurice, 2017).

> Claims that sound too good to be true usually are. Extraordinary claims require extraordinary evidence (Sagan, 1996; Shermer, 2002). What constitutes extraordinary evidence? In the strictest sense, and the sense that should be employed when evaluating claims of educational effectiveness, evidence is the outcome of the application of the scientific method to test the effectiveness of a claim, a theory, or a practice. The more rigorously the test is conducted, the more often the test is replicated, the more extensively the test is corroborated, the more extraordinary the evidence. Evidence becomes extraordinary when it is extraordinarily well tested. (Silvestri & Heward, 2016, p. 149)

We end our discussion of philosophic doubt with two pieces of advice, one from Carl Sagan and one from B. F. Skinner: "The question is not whether we *like* the conclusion that emerges out of a train of reasoning, but whether the conclusion *follows* from the premise or starting point and whether that premise is true" (Sagan, 1996, p. 210). "Regard no practice as immutable. Change and be ready to change again. Accept no eternal verity. Experiment" (Skinner, 1979, p. 346).

Other Important Attitudes and Values

The six attitudes of science that we have examined are necessary features of science and provide an important context for understanding applied behavior analysis.

However, the behavior of most productive and successful scientists is also characterized by qualities such as thoroughness, curiosity, perseverance, diligence, ethics, and honesty. Scientists acquire these traits because behaving in such ways has proven beneficial to the progress of science.

A Definition of Science

Science has no universally accepted, standard definition. We offer the following definition as one that encompasses the previously discussed purposes and attitudes of science, irrespective of the subject matter. **Science** is a systematic approach to understanding natural phenomena—as evidenced by description, prediction, and control—that relies on determinism as its fundamental assumption, empiricism as its prime directive, experimentation as its basic strategy, replication as its necessary requirement for believability, parsimony as its conservative value, and philosophic doubt as its guiding conscience.

A BRIEF HISTORY OF BEHAVIOR ANALYSIS

The science of behavior analysis entails three interrelated domains: philosophy, basic research, and applied research. **Behaviorism** is the philosophy of the science of behavior, basic research is the province of the experimental analysis of behavior (EAB), and developing a technology for improving behavior is the concern of applied behavior analysis (ABA). To be fully understood, applied behavior analysis must be considered in the context of the philosophy and basic research traditions and findings from which it evolved and remains connected today. This section provides an elementary description of the basic tenets of behaviorism and outlines some of the major events that have marked the development of behavior analysis.[3] Table 1.1 lists major books, journals, and professional organizations that have contributed to the advancement of behavior analysis since the 1930s.

Watson's Stimulus–Response Behaviorism

Psychology in the early 1900s was dominated by the study of states of consciousness, images, and other mental processes. Introspection, the act of carefully observing one's own conscious thoughts and feelings, was a primary method of investigation.

TABLE 1.1 Books, Journals, and Organizations That Have Played a Major Role in the Development and Dissemination of Behavior Analysis

Decade	Books	Journals	Organizations
1930s	*The Behavior of Organisms*—Skinner (1938)	*The Psychological Record* (1937)	
1940s	*Walden Two*—Skinner (1948)		
1950s	*Principles of Psychology*—Keller and Schoenfeld (1950)	*Journal of the Experimental Analysis of Behavior* (1958)	Society for the Experimental Analysis of Behavior (SEAB) (1957)
	Science and Human Behavior—Skinner (1953)		
	Schedules of Reinforcement—Ferster and Skinner (1957)		
	Verbal Behavior—Skinner (1957)		
1960s	*Tactics of Scientific Research*—Sidman (1960)	*Journal of Applied Behavior Analysis (1968)*	American Psychological Association's Division 25 Experimental Analysis of Behavior (1964)
	Child Development, Vols. I & II—Bijou and Baer (1961, 1965)		Experimental Analysis of Behaviour Group (UK) (1965)
	The Analysis of Behavior—Holland and Skinner (1961)		
	Research in Behavior Modification—Krasner and Ullmann (1965)		
	Operant Behavior: Areas of Research and Application—Honig (1966)		
	The Analysis of Human Operant Behavior—Reese (1966)		
	Principles of Behavioral Analysis—Millenson (1967)		
	Behavior Principles—Ferster and Perrott (1968)		
	Contingencies of Reinforcement: A Theoretical Analysis—Skinner (1969)		
1970s	*Beyond Freedom and Dignity*—Skinner (1971)	*Behaviorism* (1972) (became *Behavior and Philosophy* in 1990)	Norwegian Association for Behavior Analysis (1973)
	Elementary Principles of Behavior—Whaley and Malott (1971)	*Revista Mexicana de Analisis de la Conducta* (1975)	Midwestern Association for Behavior Analysis (MABA) (1974)
	About Behaviorism—Skinner (1974)	*Behavioural Processes* (1976)	Mexican Society of Behavior Analysis (1975)
	Single Case Experimental Designs—Hersen and Barlow (1976)	*Behavior Modification* (1977)	Association for Behavior Analysis (formerly, MABA) (1978)
	Applying Behavior-Analysis Procedures with Children and Youth—Sulzer-Azaroff and Mayer (1977)	*Journal of Organizational Behavior Management* (1977)	
	Learning—Catania (1979)	*Education & Treatment of Children* (1977)	
		The Behavior Analyst (1978)	
1980s	*Strategies and Tactics of Human Behavioral Research*—Johnston and Pennypacker (1980)	*Journal of Precision Teaching and Celeration* (formerly, *Journal of Precision Teaching*) (1980)	Society for the Advancement of Behavior Analysis (1980)
	Behaviorism: A Conceptual Reconstruction—Zuriff (1985)	*Analysis of Verbal Behavior* (1982)	
	Recent Issues in the Analysis of Behavior—Skinner (1989)	*Behavioral Interventions* (1986)	Cambridge Center for Behavioral Studies (1981)

(*continued*)

TABLE 1.1 (continued)

Decade	Books	Journals	Organizations
		Japanese Journal of Behavior Analysis (1986)	Japanese Association for Behavior Analysis (1983)
		Behavior Analysis Digest (1989)	
		Behavioural Pharmacology (1989)	
1990s	*Concepts and Principles of Behavior Analysis*—Michael (1993)	*Behavior and Social Issues* (1991)	Accreditation of Training Programs in Behavior Analysis (Association for Behavior Analysis) (1993)
	Understanding Behaviorism: Science, Behavior, and Culture—Baum (1994)	*Journal of Behavioral Education* (1991)	Behavior Analyst Certification Board (BACB) (1998)
	Radical Behaviorism: The Philosophy and the Science—Chiesa (1994)	*Journal of Positive Behavior Interventions* (1999)	Council of Directors of Graduate Programs in Behavior Analysis (Association for Behavior Analysis) (1999)
	Equivalence Relations and Behavior—Sidman (1994)	*The Behavior Analyst Today* (1999)	First Board Certified Behavior Analysts (BCBA) credentialed by the BACB (1999)
	Behavior Analysis and Learning—Pierce and Epling (1995)		
	Functional Analysis of Problem Behavior—Repp and Horner (1999)		
2000s	*Relational Frame Theory: A Post-Skinnerian Account of Human Language and Cognition*—Hayes, Barnes-Holmes, and Roche (2001)	*European Journal of Behavior Analysis* (2000)	
	Conceptual Foundations of Radical Behaviorism—Moore (2008)	*Behavioral Development Bulletin* (2002)	
		Journal of Early and Intensive Behavior Intervention (2004)	European Association for Behaviour Analysis (2002)
		Brazilian Journal of Behavior Analysis (2005)	Association for Professional Behavior Analysts (APBA) (2007)
		International Journal of Behavioral Consultation and Therapy (2005)	Association for Behavior Analysis International (ABAI) (formerly, ABA) (2008)
2010s	*Handbook of Applied Behavior Analysis*—Fisher, Piazza, and Roane (2011)	*Behavior Analysis in Practice* (2011)	First Registered Behavior Technician (RBT) credentialed by the BACB (2014)
	The Science of Consequences—Schneider (2012)	*Journal of Contextual Behavioral Science* (2012)	BACB credentials the 30,000th behavior analyst (2018)
	APA Handbook of Behavior Analysis—Madden (2013)	*Operants* (2014)	Membership in ABAI and affiliate chapters surpasses 26,000 in 63 countries (2018)
	Radical Behaviorism for ABA Practitioners—Johnston (2013)	*Behavior Analysis: Research and Practice* (formerly, *The Behavior Analyst Today* (2015)	
	The Wiley-Blackwell Handbook of Operant and Classical Conditioning—McSweeney and Murphy (2014)	*Perspectives on Behavior Science* (formerly, *The Behavior Analyst*) (2018)	
	The Nurture Effect: How the Science of Human Behavior Can Improve Our Lives & Our World—Biglan (2015)		

Note: Books are listed by initial year of publication. Some titles are available in more recent editions.

B. F. Skinner *(left)* in his Indiana University lab circa 1945 and *(right)* circa 1967.

Although the authors of several texts in the first decade of the 20th century defined psychology as the science of behavior (see Kazdin, 1978), John B. Watson is widely recognized as the spokesman for a new direction in the field of psychology. In his influential article "Psychology as the Behaviorist Views It," Watson (1913) wrote:

> Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness. (p. 158)

Watson argued that the proper subject matter for psychology was not states of mind or mental processes but observable behavior. Further, the objective study of behavior as a natural science should consist of direct observation of the relationships between environmental stimuli (S) and the responses (R) they evoke. Watsonian behaviorism became known as stimulus–response (S–R) psychology. Although scientific evidence was insufficient to support S–R psychology as a workable explanation for most behavior, Watson was confident that his new behaviorism would lead to the prediction and control of human behavior and that it would allow practitioners to improve performance in areas such as education, business, and law. Watson (1924) made bold claims concerning human behavior, as illustrated in this famous quotation:

> Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors. I am going beyond my facts and I admit it, but so have the advocates of the contrary and they have been doing it for many thousands of years. (p. 104)

It is unfortunate that such extraordinary claims were made, exaggerating the ability to predict and control human behavior beyond the scientific knowledge available. The quotation just cited has been used to discredit Watson and continues to be used to discredit behaviorism in general, even though the behaviorism that underlies contemporary behavior analysis is fundamentally different from the S–R paradigm. Nevertheless, Watson's contributions were of great significance: He made a strong case for the study of behavior as a natural science on a par with the physical and biological sciences.[4]

Experimental Analysis of Behavior

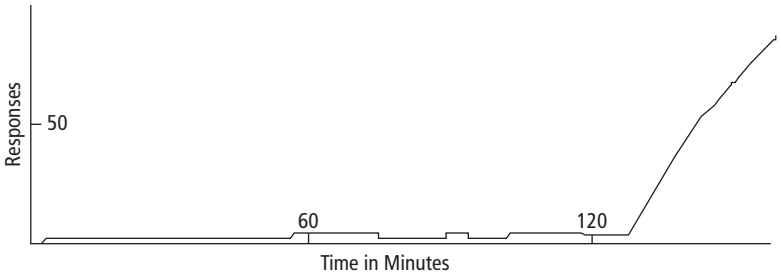
> *[Science] is a search for order. It begins, as we all begin, by observing single episodes, but it quickly passes on to the general rule, to scientific law.*
>
> —B. F. Skinner, (1953, pp. 13–14)

> *I had the clue from Pavlov: Control your conditions and you will see order.*
>
> —B. F. Skinner, (1956, p. 223)

The experimental branch of behavior analysis formally began with the publication of B. F. Skinner's *the Behavior of Organisms* (1938). The book summarized Skinner's laboratory research conducted from 1930 to 1937 and brought into perspective two kinds of behavior: respondent and operant.

Respondent behavior is reflexive behavior as in the tradition of Ivan Pavlov (1927). Respondents are elicited, or "brought out," by stimuli that immediately precede them. The antecedent stimulus (e.g., bright light) and the response it elicits (e.g., pupil constriction) form a functional unit called a *reflex.* Respondent behaviors are essentially involuntary and occur whenever the eliciting stimulus is presented.

Skinner was "interested in giving a scientific account of all behavior, including that which Descartes had set aside as 'willed' and outside the reach of science" (Glenn, Ellis, & Greenspoon, 1992, p. 1330). But, like other psychologists of the time, Skinner found that the S–R paradigm could not explain a great deal of behavior, particularly behaviors that had no



Original Conditioning
All responses to the lever were reinforced. The first three reinforcements were apparently ineffective. The fourth is followed by a rapid increase in rate.

Figure 1.1 The first data set in B. F. Skinner's *The Behavior of Organisms: An Experimental Analysis* (1938).

Based on *the Behavior of Organisms: An Experimental Analysis* by B. F. Skinner, p. 67. Original copyright 1938 by Appleton-Century. Copyright 1991 by B. F. Skinner Foundation, Cambridge, MA. Used by permission.

apparent antecedent causes in the environment. Compared to reflexive behavior with its clear eliciting events, much of the behavior of organisms appeared spontaneous or "voluntary." In an attempt to explain the mechanisms responsible for "voluntary" behavior, other psychologists postulated mediating variables inside the organism in the form of hypothetical constructs such as cognitive processes, drives, and free will. Skinner took a different tack. Instead of creating **hypothetical constructs**, presumed but unobserved entities that could not be manipulated in an experiment, Skinner continued to look in the environment for the determinants of behavior that did not have apparent antecedent causes.

> He did not deny that physiological variables played a role in determining behavior. He merely felt that this was the domain of other disciplines, and for his part, remained committed to assessing the causal role of the environment. This decision meant looking elsewhere in time. Through painstaking research, Skinner accumulated significant, if counterintuitive, evidence that behavior is changed less by the stimuli that precede it (though context is important) and more by the consequences that immediately follow it (i.e., consequences that are contingent upon it). The essential formulation for this notion is S–R–S, otherwise known as the three–term contingency. It did not replace the S–R model—we still salivate, for instance, if we smell food cooking when we are hungry. It did, however, account for how the environment "selects" the great part of learned behavior.
>
> With the three-term contingency Skinner gave us a new paradigm. He achieved something no less profound for the study of behavior and learning than Bohr's model of the atom or Mendel's model of the gene. (Kimball, 2002, p. 71)

Skinner called the second type of behavior *operant behavior.*[5] Operant behaviors are not elicited by preceding stimuli but instead are influenced by stimulus changes that have followed the behavior in the past. Skinner's most powerful and fundamental contribution to our understanding of behavior was his discovery and experimental analyses of the effects of consequences on behavior. The operant three-term contingency as the primary unit of analysis was a revolutionary conceptual breakthrough.

Skinner (1938) argued that the analysis of operant behavior "with its unique relation to the environment presents a separate important field of investigation" (p. 438). He named this new science the **experimental analysis of behavior** and outlined the methodology for its practice. Simply put, Skinner recorded the rate at which a single subject (he initially used rats and later, pigeons) emitted a given behavior in a controlled and standardized experimental chamber.

The first set of data Skinner presented in *The Behavior of Organisms* was a graph that "gives a record of the resulting change in behavior" (p. 67) when a food pellet was delivered immediately after a rat pressed a lever (see Figure 1.1). Skinner noted that the first three times that food followed a response "had no observable effect" but that "the fourth response was followed by an appreciable increase in rate showing a swift acceleration to a maximum" (pp. 67–68).

Skinner's investigative procedures evolved into an elegant experimental approach that enabled clear and powerful demonstrations of orderly and reliable functional relations between behavior and various types of environmental events.[6] By systematically manipulating the arrangement and scheduling of stimuli that preceded and followed behavior in literally thousands of laboratory experiments from the 1930s through the 1950s, Skinner and his colleagues and students discovered and verified the basic principles of operant behavior that continue to provide the empirical foundation for behavior analysis today. Description of these principles of behavior—general statements of functional relations between behavior and environmental events—and tactics for changing behavior derived from those principles constitute a major portion of this text.

Skinner's Radical Behaviorism

> *Behavior analysts dispense with the myth of the inner person as creator of behavior. Both philosophically and empirically to the behavior analyst, we are what we do, and when and where we do it.*
>
> —Murray Sidman, (2013, p. xvi)

In addition to being the founder of the experimental analysis of behavior, B. F. Skinner wrote extensively on the philosophy of that science. Without question, Skinner's writings have been the most influential both in guiding the practice of the science of behavior and in proposing the application of the principles of behavior to new areas.[7] In 1948 Skinner published *Walden Two,* a fictional account of how the philosophy and principles of behavior might be used in a utopian community (see Altus & Morris, 2009). This was

followed by his classic text, *Science and Human Behavior* (1953), in which he speculated on how the principles of behavior might be applied to complex human behavior in areas such as education, religion, government, law, and psychotherapy.

Much of Skinner's writing was devoted to the development and explanation of his philosophy of behaviorism. Skinner began his book *About Behaviorism* (1974) with these words:

> Behaviorism is not the science of human behavior; it is the philosophy of that science. Some of the questions it asks are these: Is such a science really possible? Can it account for every aspect of human behavior? What methods can it use? Are its laws as valid as those of physics and biology? Will it lead to a technology, and if so, what role will it play in human affairs? (p. 1)

The behaviorism Skinner pioneered differed significantly (indeed, radically) from other psychological theories, including other forms of behaviorism. Although there were, and remain today, many psychological models and approaches to the study of behavior, **mentalism** is the common denominator among most.

> In general terms, *mentalism* may be defined as an approach to the study of behavior which assumes that a mental or "inner" dimension exists that differs from a behavioral dimension. This dimension is ordinarily referred to in terms of its neural, psychic, spiritual, subjective, conceptual, or hypothetical properties. Mentalism further assumes that phenomena in this dimension either directly cause or at least mediate some forms of behavior, if not all. These phenomena are typically designated as some sort of act, state, mechanism, process, or entity that is causal in the sense of initiating or originating. Mentalism regards concerns about the origin of these phenomena as incidental at best. Finally, mentalism holds that an adequate causal explanation of behavior must appeal directly to the efficacy of these mental phenomena. (Moore, 2003, pp. 181–182)

Hypothetical constructs and explanatory fictions are the stock and trade of mentalism, which has dominated Western intellectual thought and most psychological theories (Descartes, Freud, Piaget), and it continues to do so into the 21st century. Freud, for example, created a complex mental world of hypothetical constructs—the id, ego, and superego—that he contended were key to understanding a person's actions.

Hypothetical constructs—"theoretical terms that refer to a possibly existing, but at the moment unobserved process or entity" (Moore, 1995, p. 36)—can be neither observed nor experimentally manipulated (MacCorquodale & Meehl, 1948; Zuriff, 1985). Free will, readiness, innate releasers, language acquisition devices, storage and retrieval mechanisms for memory, and information processing are all examples of hypothetical constructs that are inferred from behavior. Although Skinner (1953, 1974) clearly indicated that it is a mistake to rule out events that influence our behavior because they are not accessible to others, he believed that using presumed but unobserved mentalistic fictions (i.e., hypothetical constructs) to explain the causes of behavior contributed nothing to a functional account.

Consider a typical laboratory situation. A food-deprived rat pushes a lever each time a light comes on and receives food, but the rat seldom pushes the lever when the light is off (and if it does, no food is delivered). When asked to explain why the rat pushes the lever only when the light is on, most will say that the rat has "made the association" between the light being on and food being delivered when the lever is pressed. As a result of making that association, the animal now "knows" to press the lever only when the light is on. Attributing the rat's behavior to a hypothetical cognitive process such as associating or to something called "knowledge" adds nothing to a functional account of the situation. First, the environment (in this case, the experimenter) paired the light and food availability for lever presses, not the rat. Second, the knowledge or other cognitive process that is said to explain the observed behavior is itself unexplained, which begs for still more conjecture.

The "knowledge" that is said to account for the rat's performance is an example of an **explanatory fiction**, a fictitious variable that often is simply another name for the observed behavior that contributes nothing to an understanding of the variables responsible for developing or maintaining the behavior. Explanatory fictions are the key ingredient in "a circular way of viewing the cause and effect of a situation" (Heron, Tincani, Peterson, & Miller, 2005, p. 274) that lead to a false sense of understanding.

> Turning from observed behavior to a fanciful inner world continues unabated. Sometimes it is little more than a linguistic practice. We tend to make nouns of adjectives and verbs and must then find a place for the things the nouns are said to represent. We say that a rope is strong and before long we are speaking of its strength. We call a particular kind of strength tensile, and then explain that the rope is strong *because* it possesses tensile strength. The mistake is less obvious but more troublesome when matters are more complex.
>
> Consider now a behavioral parallel. When a person has been subject to mildly punishing consequences in walking on a slippery surface, he may walk in a manner we describe as cautious. It is then easy to say that he walks with caution or that he shows caution. There is no harm in this until we begin to say that he walks carefully *because* of his caution. (Skinner, 1974, pp. 165–166, emphasis added)

It is widely believed that Skinner rejected all events that could not be independently verified by agreement among observers. However, Skinner was explicit early on that he valued effective action over agreement among observers.

> The ultimate criterion for the goodness of a concept is not whether two people are brought into agreement but whether the scientist who uses the concept can operate successfully upon his material—all by himself if need be. What matters to Robinson Crusoe is not whether he is agreeing with himself but whether he is getting anywhere with his control over nature. (Skinner, 1945, p. 293).

Pragmatism, the philosophical position that "the truth value of a statement is a function of how well the statement promotes effective action" (Moore, 2008, p. 400), continues to be a primary criterion by which behavior analysts judge the value of their findings (Leigland, 2010; Moxley, 2004).[8]

In reality, there are many kinds of behaviorism—structuralism, methodological behaviorism, and forms of behaviorism that use cognitions as causal factors (e.g., cognitive behavior modification and social learning theory)—in addition to the radical behaviorism of Skinner. Structuralism and methodological behaviorism do reject all events that are not operationally defined by objective assessment. Structuralists avoid mentalism by restricting their activities to descriptions of behavior. They make no scientific manipulations; accordingly, they do not address questions of causal factors. Methodological behaviorists differ from the structuralists by using scientific manipulations to search for functional relations between events. Uncomfortable with basing their science on unobservable phenomena, some early behaviorists either denied the existence of "inner variables" or considered them outside the realm of a scientific account. Such an orientation is often referred to as **methodological behaviorism**.

Methodological behaviorists acknowledge the existence of mental events but do not consider them in the analysis of behavior (Skinner, 1974). Methodological behaviorists' reliance on public events, excluding private events, restricts the knowledge base of human behavior and discourages innovation in the science of behavior. Methodological behaviorism is restrictive because it ignores areas of major importance for an understanding of behavior.

Contrary to another common misconception, Skinner did not object to cognitive psychology's concern with private events (i.e., events taking place "inside the skin") (Moore, 2000). Skinner was the first behaviorist to view thoughts and feelings (he called them "private events") as behavior to be analyzed with the same conceptual and experimental tools used to analyze publicly observable behavior, not as phenomena or variables that exist within and operate according to principles of a separate mental world. "I contend that my toothache is just as physical as my typewriter" (Skinner, 1945, p. 294).

Essentially, Skinner's behaviorism makes three major assumptions regarding the nature of private events: (a) Private events such as thoughts and feelings are behavior; (b) behavior that takes place within the skin is distinguished from other ("public") behavior only by its inaccessibility; and (c) private behavior is influenced by (i.e., is a function of) the same kinds of variables as publicly accessible behavior.

> We need not suppose that events which take place within an organism's skin have special properties for that reason. A private event may be distinguished by its limited accessibility but not, so far as we know, by any special structure of nature. (Skinner, 1953, p. 257)

By incorporating private events into an overall conceptual system of behavior, Skinner created a **radical behaviorism** that includes and seeks to understand all human behavior. "What is inside the skin, and how do we know about it? The answer is, I believe, the heart of radical behaviorism" (Skinner, 1974, p. 218). The proper connotations of the word *radical* in radical behaviorism are *far-reaching* and *thoroughgoing,* connoting the philosophy's inclusion of all behavior, public and private. *Radical* is also an appropriate modifier for Skinner's form of behaviorism because it represents a dramatic departure from other conceptual systems in calling for

> probably the most drastic change ever proposed in our way of thinking about man. It is almost literally a matter of turning the explanation of behavior inside out. (Skinner, 1974, p. 256)

Skinner and the philosophy of radical behaviorism acknowledge the events on which fictions such as cognitive processes are based. Radical behaviorism does not restrict the science of behavior to phenomena that can be detected by more than one person. In the context of radical behaviorism, the term *observe* implies "coming into contact with" (Moore, 1984). Radical behaviorists consider private events such as thinking or sensing the stimuli produced by a damaged tooth to be no different from public events such as oral reading or sensing the sounds produced by a musical instrument. According to Skinner (1974), "What is felt or introspectively observed is not some nonphysical world of consciousness, mind, or mental life but the observer's own body" (pp. 18–19).

The analysis of private events is a major aspect of radical behaviorism and indispensable for a comprehensive science of behavior (Palmer, 2011). Moore (1980, 2015) stated it concisely:

> For radical behaviorism, private events are those events wherein individuals respond with respect to certain stimuli accessible to themselves alone. . . . The responses that are made to those stimuli may themselves be public, i.e., observable by others, or they may be private, i.e., accessible only to the individual involved. Nonetheless, to paraphrase Skinner (1953), it need not be supposed that events taking place within the skin have any special properties for that reason alone. . . . For radical behaviorism, then, one's responses with respect to private stimuli are equally lawful and alike in kind to one's responses with respect to public stimuli. (1980, p. 460)

> [T]hese events are critical to understanding behavior in all its complexity. Just as importantly, they need not be formulated in different terms and with different concepts that are publicly observable behavior events. (2015, p. 18)

Scientists and practitioners are affected by their own social context, and institutions and schools are dominated by mentalism (Heward & Cooper, 1992; Kimball, 2002). A firm grasp of the philosophy of radical behaviorism, in addition to knowledge of principles of behavior, can help the scientist and practitioner resist the mentalistic approach of dropping the search for controlling variables in the environment and drifting toward explanatory fictions in the effort to understand behavior. The principles of behavior and the procedures presented in this text apply equally to public and private events. Radical

behaviorism is the philosophical position underlying the content presented in this text.

As Friman (2017) noted, Skinner's behaviorism viewed behavior as a natural science.

> By taking this stand, he was promoting a larger idea, specifically that behavior was solely a physical phenomenon brought about, maintained, strengthened, or weakened solely by physical (environmental) events. In other words, he was promoting the idea that behavior is a function of environmental circumstances and their context. This is the most powerful idea ever invented by mankind for understanding, knowing, and approaching human behavior especially when it is a problem. (p. 176)

A thorough discussion of radical behaviorism is far beyond the scope of this text. The serious student of applied behavior analysis will devote considerable study to Skinner's original writings and to other authors who have critiqued, analyzed, and extended the philosophical foundations of the science of behavior.[9] (See Box 1.1 for Don Baer's perspectives on the meaning and importance of radical behaviorism.)

Applied Behavior Analysis

The first study to report the human application of principles of operant behavior was conducted by Fuller (1949). The subject was an 18-year-old boy with profound developmental disabilities who was described in the language of the time as a "vegetative idiot." He lay on his back, unable to roll over. Fuller filled a syringe with a warm sugar-milk solution and injected a small amount of the fluid into the young man's mouth every time he moved his right arm (that arm was chosen because he moved it infrequently). Within four sessions the boy was moving his arm to a vertical position at a rate of three times per minute.[10]

> The attending physicians . . . thought it was impossible for him to learn anything—according to them, he had not learned anything in the 18 years of his life—yet in four experimental sessions, by using the operant conditioning technique, an addition was made to his behavior which, at this level, could be termed appreciable. Those who participated in or observed the experiment are of the opinion that if time permitted, other responses could be conditioned and discriminations learned. (Fuller, 1949, p. 590)

During the 1950s and into the early 1960s researchers used the methods of the experimental analysis of behavior to determine whether the principles of behavior demonstrated in the laboratory with nonhuman subjects could be replicated with humans. According to Thompson and Hackenberg (2009), "the field of applied analysis emerged from the experimental analysis of behavior, like Adam's rib" (p. 271).

Much of the early research with human subjects was conducted in clinic or laboratory settings. Although the participants typically benefited from these studies by learning new behaviors, the researchers' major purpose was to determine whether the basic principles of behavior discovered in the laboratory operated with humans. For example, Sidney Bijou (1955, 1957, 1958)[11] researched several principles of behavior with typically developing subjects and people with intellectual disabilities; Don Baer (1960, 1961, 1962) examined the effects of punishment, escape, and avoidance contingencies on preschool children; and Ogden Lindsley (1956; Lindsley & Skinner, 1954) assessed the effects of operant conditioning on the behavior of adults with schizophrenia. These early researchers clearly established that the principles of behavior are applicable to human behavior, and they set the stage for the later development of applied behavior analysis.

The branch of behavior analysis that would later be called applied behavior analysis (ABA) can be traced to the 1959 publication of Ayllon and Michael's paper titled "The Psychiatric Nurse as a Behavioral Engineer." The authors described how direct care personnel in a state hospital used a variety of techniques based on the principles of behavior to improve the functioning of residents with psychotic disorders or intellectual disabilities. During the 1960s many researchers began to apply principles of behavior in an effort to improve socially important behavior, but these early pioneers faced many problems. Laboratory techniques for measuring behavior and for controlling and manipulating variables were sometimes unavailable, or their use was inappropriate in applied settings. As a result, the early practitioners of applied behavior analysis had to develop new experimental procedures as they went along. There was little funding for the new discipline, and researchers had no ready outlet for publishing their studies, making it difficult to communicate among themselves about their findings and solutions to methodological problems. Most journal editors were reluctant to publish studies using an experimental method unfamiliar to mainstream social science, which relied on large numbers of subjects and tests of statistical inference.

Despite these problems it was an exciting time, and major new discoveries were being made regularly. For example, many pioneering applications of behavior principles to education occurred during this period (see, e.g., O'Leary & O'Leary, 1972; Ulrich, Stachnik, & Mabry 1974), from which were derived teaching procedures such as contingent teacher praise and attention (Hall, Lund, & Jackson, 1968), token reinforcement systems (Birnbrauer, Wolf, Kidder, & Tague, 1965), curriculum design (Becker, Engelmann, & Thomas, 1975), and programmed instruction (Bijou, Birnbrauer, Kidder, & Tague, 1966; Markle, 1962). The basic methods for reliably improving student performance developed by those early applied behavior analysts provided the foundation for behavioral approaches to curriculum design, instructional methods, classroom management, and the generalization and maintenance of learning that continue to be used decades later (cf., Twyman, 2013).

University programs in behavior analysis were begun in the 1960s and 1970s at Arizona State University, Florida State University, the State University of New York at Stony Brook,

BOX 1.1

What Is Behaviorism?

Don Baer loved the science of behavior. He loved to write about it, and he loved to talk about it. Don was famous for his unparalleled ability to speak extemporaneously about complex philosophical, experimental, and professional issues in a way that always made thorough conceptual, practical, and human sense. He did so with the vocabulary and syntax of a great author and the accomplished delivery of a master storyteller. The only thing Don knew better than his audience was his science.

On three occasions, in three different decades, graduate students and faculty in the special education program at The Ohio State University were fortunate to have Professor Baer serve as Distinguished Guest Faculty for a doctoral seminar, Contemporary Issues in Special Education and Applied Behavior Analysis. The questions and responses that follow were selected from transcripts of two of Professor Baer's three OSU teleconference seminars.

If a person on the street approached you and asked, "What's behaviorism?" how would you reply?

The key point of behaviorism is that what people do can be understood. Traditionally, both the layperson and the psychologist have tried to understand behavior by seeing it as the outcome of what we think, what we feel, what we want, what we calculate, and etcetera. But we don't have to think about behavior that way. We could look upon it as a process that occurs in its own right and has its own causes. And those causes are, very often, found in the external environment.

Behavior analysis is a science of studying how we can arrange our environments so they make very likely the behaviors we want to be probable enough, and they make unlikely the behaviors we want to be improbable. Behaviorism is understanding how the environment works so that we can make ourselves smarter, more organized, more responsible; so we can encounter fewer punishments and fewer disappointments. A central point of behaviorism is this: We can remake our environment to accomplish some of that much more easily than we can remake our inner selves.

An interviewer once asked Edward Teller, the physicist who helped develop the first atomic bomb, "Can you explain to a nonscientist what you find so fascinating about science, particularly physics?" Teller replied, "No." I sense that Teller was suggesting that a nonscientist would not be able to comprehend, understand, or appreciate physics and his fascination with it. If a nonscientist asked you, "What do you find so fascinating about science, particularly the science of human behavior?" what would you say?

Ed Morris organized a symposium on just this topic a couple of years ago at the Association for Behavior Analysis annual convention, and in that symposium, Jack Michael commented on the fact that although one of our discipline's big problems and challenges is communicating with our society about who we are, what we do, and what we can do, he didn't find it reasonable to try to summarize what behavior analysis is to an ordinary person in just a few words. He gave us this example: Imagine a quantum physicist is approached at a cocktail party by someone who asks, "What is quantum physics?" Jack said that the physicist might very well answer, and probably should answer, "I can't tell you in a few words. You should register for my course."

I'm very sympathetic with Jack's argument. But I also know, as someone who's confronted with the politics of relating our discipline to society, that although it may be a true answer, it's not a good answer. It's not an answer that people will hear with any pleasure, or indeed, even accept. . . . Therefore, I think we have to engage in a bit of honest show business. So, if I had to somehow state some connotations of what holds me in the field, I guess I would say that since I was a child I always found my biggest reinforcer was something called understanding. I liked to know how things worked. And of all of the things in the world there are to understand, it became clear to me that the most fascinating was what people do. I started with the usual physical science stuff, and it was intriguing to me to understand how radios work, and how electricity works, and how clocks work, etcetera. But when it became clear to me that we could also learn how people work—not just biologically, but behaviorally—I thought that's the best of all. Surely, everyone must agree that that's the most fascinating subject matter. That there could be a science of behavior, of what we do, of who we are? How could you resist that?

Adapted from "Thursday Afternoons with Don: Selections from Three Teleconference Seminars on Applied Behavior Analysis" by W. L. Heward & C. L. Wood (2003). In K. S. Budd & T. Stokes (Eds.), *A Small Matter of Proof: The Legacy of Donald M. Baer* (pp. 293–310). Reno, NV: Context Press. Used by permission.

the University of Illinois, Indiana University, the University of Kansas, The Ohio State University, the University of Oregon, the University of Southern Illinois, the University of Washington, West Virginia University, and Western Michigan University, among others. Through their teaching and research, faculty at each of these programs made major contributions to the rapid growth of the field.[12]

Two significant events in 1968 mark that year as the formal beginning of contemporary applied behavior analysis. First, the *Journal of Applied Behavior Analysis (JABA)* began publication. *JABA* was the first journal in the United States to deal with applied problems that gave researchers using methodology from the experimental analysis of behavior an outlet for publishing their findings. *JABA* was and continues to be the flagship journal