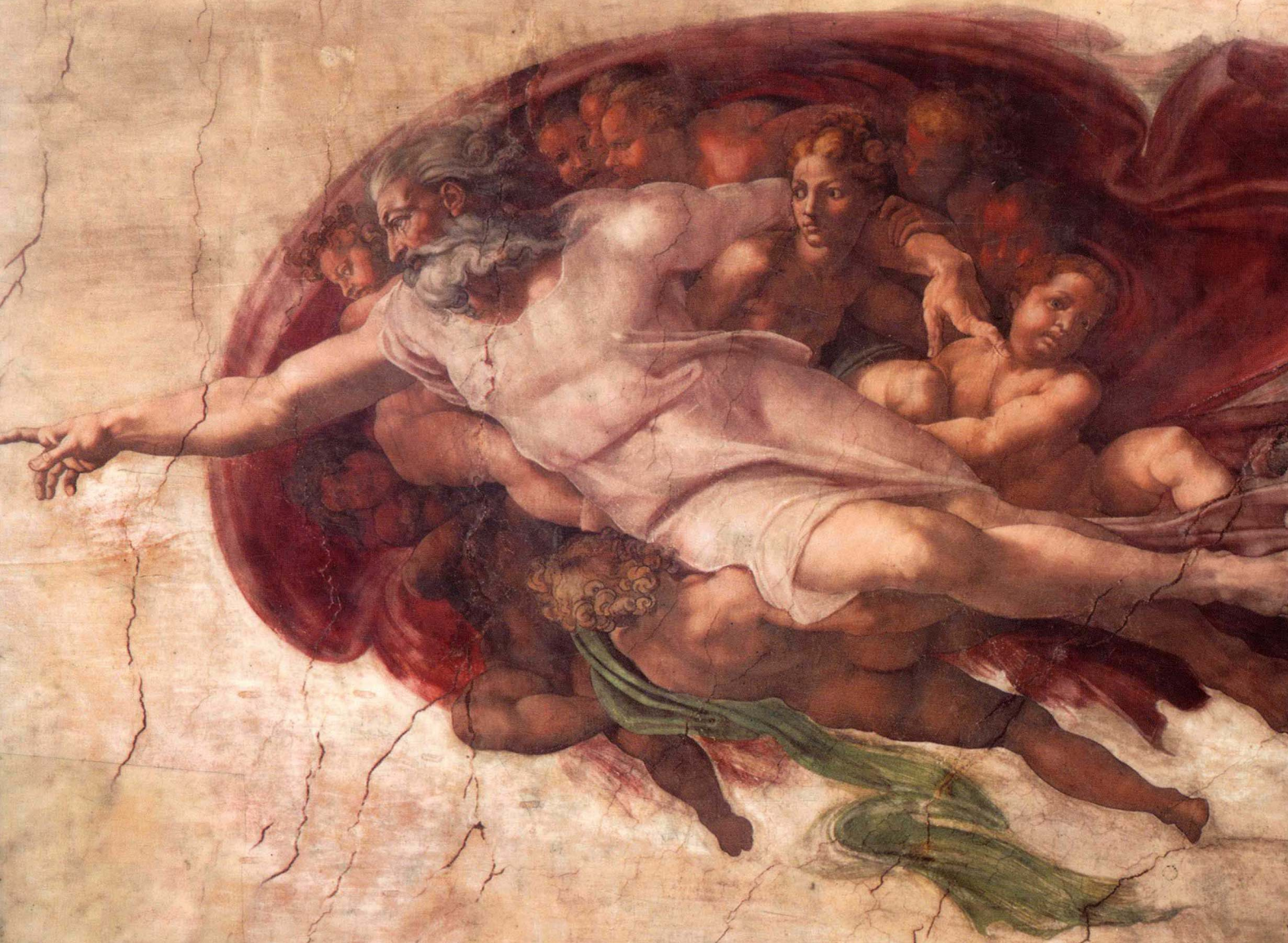


Biological Psychology

AN INTRODUCTION TO BEHAVIORAL
AND COGNITIVE NEUROSCIENCE

FOURTH EDITION

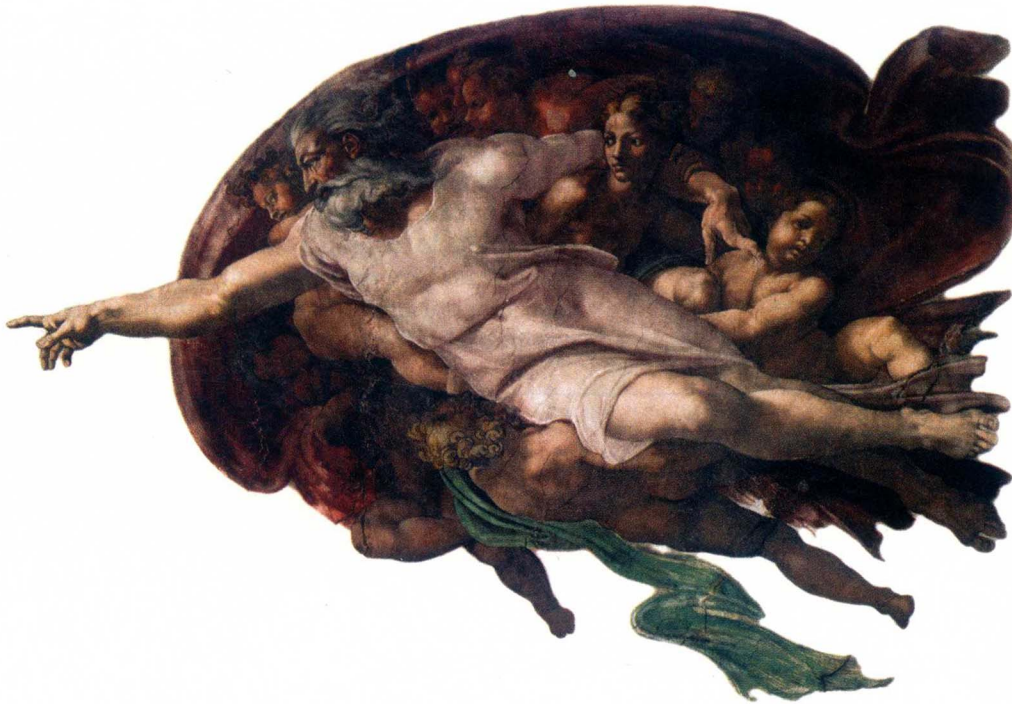


Mark R. Rosenzweig • S. Marc Breedlove • Neil V. Watson

Biological Psychology

AN INTRODUCTION TO BEHAVIORAL
AND COGNITIVE NEUROSCIENCE

FOURTH EDITION



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About the Cover

A Brain On the Ceiling of the Sistine Chapel?

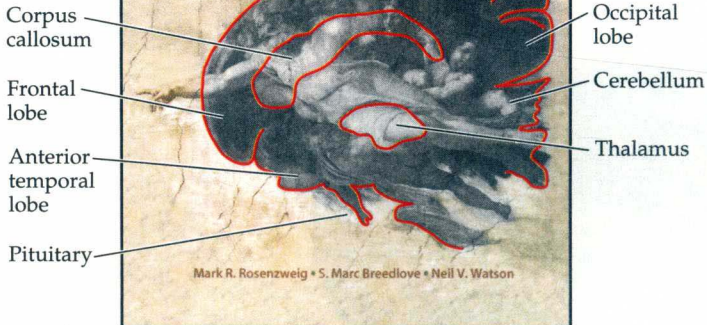
In one of the panels of the ceiling of the Sistine Chapel, Michelangelo Buonarroti's masterpiece "The Creation of Adam" (painted 1508–1512) depicts God reaching out to bestow the gift of life upon humanity, through Adam. But the oddly shaped drapery behind God, and the arrangement of his attendants, has prompted speculation that Michelangelo was conveying a hidden message: God and attendants appear to be part of a human brain (Meshberger, 1990).

As illustrated here, it requires only a little imagination to identify the broad outlines of a brain in Michelangelo's depiction of God (compare it with the midsagittal section of a human brain in Figure 2.7). During the Renaissance, when this fresco was created, the all-powerful Church forbade depiction of the dissected human body, considering it to be a desecration. But there is no doubt that Michelangelo engaged in extensive dissections of cadavers, gaining the detailed knowledge of human anatomy that informs his sculpture and paintings. It is highly likely that he knew perfectly well what a dissected human brain looks like. So was Michelangelo making a subtle commentary about the origins of behavior? We probably will never know. But it is now clear that our uniquely human qualities—language, reason, emotion, and the rest—are products of the brain.

Biological Psychology

AN INTRODUCTION TO BEHAVIORAL
AND COGNITIVE NEUROSCIENCE

FOURTH EDITION



Biological Psychology, Fourth Edition

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*We dedicate this book affectionately to our wives, children, and grandchildren.
We appreciate their support and patience over the years of this project.*

M.R.R.

Janine

*Anne
Jim*

*Suzanne
Kent*

*Philip
Laura*

*Lauren
David*

*Gregory
Elise*

*Thomas
Caroline*

S.M.B.

Cindy

Ben

Nick

Tessa

Kit

N.V.W.

Maria

Bix

Sophie

Lia

Preface

These days, the newspapers, magazines, and TV are chock full of intriguing and sometimes astonishing stories about how the brain functions. On any given day, our website (www.biopsychology.com) posts three or more biopsychology news stories, all drawn from the wire services and major newsfeeds. Neuroscience seems poised to answer so many formerly mysterious questions:

- Does stem-cell research hold the promise of treatments for neurological disorders like Alzheimer's disease and Parkinson's disease?
- Does the brain make new neurons throughout life, in numbers large enough to make a functional difference? Can we control this process?
- Can we improve memory performance by manipulating genes, or diets, or drugs?
- Does strong liking for sweet foods involve the same brain mechanisms as addiction to drugs?
- How can recent discoveries about the neural control of appetite help us to curb the obesity epidemic?
- Does a gene that predisposes for Alzheimer's disease impair memory even in those who do not develop the disease?

These are important questions, but the basic issues surrounding them cannot be reduced to "sound bites." A meaningful approach to questions like these requires an understanding of the bodily systems that underlie behavior and experience. Our aim in *Biological Psychology* is to provide a foundation that places these and other important problems in a unified scientific context.

This book explores the biological bases of our experience and behavior: the ways in which bodily states and processes produce and control behavior and cognition, and—just as important—the ways in which behavior, cognition, and the environment exert their influence on bodily systems. We treat biology in a broad sense. As in most textbooks of this sort, there is substantial coverage of the proximate, physiological underpinnings of behavior, but we have also related these systems to their ultimate, evolutionary origins whenever possible. The focus of the book is human behavior, but we include numerous discussions of other species' solutions to the problems of survival as well.

Many scientific disciplines contribute to these themes, so we draw upon the research of psychologists, anatomists, biochemists, endocrinologists, engineers, geneticists, immunologists, neurologists, physiologists, evolutionary biologists, and zoologists. In order to gain a panoramic view of the questions that concern biological psychologists, we have tried to rise above the limits of any single specialty. Throughout the book we employ a five-fold approach to biological psychology—

descriptive, comparative/evolutionary, developmental, mechanistic, and applied/clinical. We also emphasize the remarkable plasticity of the nervous system; it is increasingly evident that this malleability is a general feature of neural tissue.

In our experience, students enrolled in biological psychology courses can be quite diverse in terms of their academic backgrounds and their personal interests, so we have taken pains to make the subject as accessible as possible to the widest spectrum of students by providing both the behavioral and biological foundations for each main topic. Some students will feel comfortable skipping or skimming some of this background material, but others will benefit from studying it carefully before moving on to the core of each chapter.

We have adopted an ordering of chapters that seems logical to us, but we realize that some instructors may prefer to teach topics in a different order or to omit some chapters entirely, so we have written each chapter as a relatively self-contained unit. Recognizing that courses also vary in length from a single quarter or semester to two semesters, we wrote the text with the intent that it could be reasonably covered in a single quarter by omitting a few chapters, but the text provides enough material for a two-quarter or even a two-semester course. We have successfully taught the course using the book in each of these settings. Specific suggestions for creating syllabi with different emphases can be found in the Instructor's Manual, along with detailed outlines for lectures and other helpful material. In addition, the Instructor's Resource CD contains many resources for use in the lecture, such as animations, videos, and PowerPoint® slides of every figure in the book. (For more information on the media and supplements, turn to page XVIII.)

Many features of the text are designed to enhance students' mastery of the material:

- We have continued to develop what we believe is the finest full-color illustration program in any biological psychology text. This acclaimed art program has undergone hundreds of additions and refinements, always with a clear pedagogical goal in mind. Data from original sources have been recast in ways that are designed to aid the student's understanding. All-new photographs and drawings—clear, detailed, and consistent—are another feature of this edition.
- Each chapter opens with a vivid vignette that places the chapter content in a real-world context, serving to draw the reader into the relevant research issues from the outset; the vignette is eventually resolved within the body of the chapter. Each chapter concludes with a Summary and list of Recommended Reading.
- Key terms are set in boldface type where first defined, and are also included in an improved, more comprehensive Glossary.
- “Boxes” describe interesting applications, important methods, sidelights, or refreshers on theoretical concepts relevant to biological psychology, or place the findings in the chapter in a historical perspective.
- Icons in the margins call attention to six special aspects of the text:



We frequently underscore the point that science is a process, and that it advances by continually testing competing hypotheses to account for observations. As examples in the text illustrate, sometimes further research indicates which of a group of hypotheses is correct; sometimes all the hypotheses are rejected for a new, more adequate hypothesis.

**IMPORTANT
METHOD**

Many of the stunning advances in neuroscience in recent years are due to the introduction of powerful new methods that have made it possible to make progress on previously intractable problems. This icon highlights these new methods as well as more venerable research techniques. Important animal models used in research are also highlighted with this icon.

**GENES AND
BEHAVIOR**

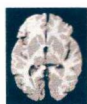
The revolution in molecular biology is clarifying many of the mechanisms involved in genetic influences on behavior, and this icon highlights important examples.

**EVOLUTION
AT WORK**

Evolution is a major theme of current research on neuroscience and behavior, and we highlight many examples.

**NEURAL
PLASTICITY**

As noted above, plasticity of the nervous system is an important theme in the text. This icon calls attention to particularly robust examples of plasticity.

**CLINICAL
ISSUE**

Discussion of clinical issues occurs frequently in the text, and this icon points out discussions of important disorders of the nervous system.



Learning Biological Psychology, our comprehensive electronic study guide revised and updated by Raymond Kesner and David Vago of the University of Utah, is a powerful companion to the textbook that enhances the learning experience with a variety of multimedia resources. The CD icon appears wherever the student can make use of the interactive activities or animations included in *Learning Biological Psychology* to clarify important concepts.

Some of the most satisfying experiences in writing—and revising—this book have been the lively and creative discussions among the authors. Each of us has a different research focus, and each of us is involved in certain fields more fully than the others. Pooling our experiences and discussing the relevance of findings in one area to other aspects of biological psychology has been a rewarding experience, and we believe that this integration of knowledge from diverse but complementary fields has enriched the book.

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MARK R. ROSENZWEIG • S. MARC BREEDLOVE • NEIL V. WATSON

Supplements *to accompany Biological Psychology, Fourth Edition*

For the Student

Learning Biological Psychology CD-ROM

Study Material by Raymond Kesner and David Vago, *University of Utah*; Animated Tutorials by Sumanas, Inc. *Learning Biological Psychology*, included in every copy of the textbook, is an interactive CD study guide designed to help the student grasp the material introduced in the textbook. Combining the best features of a study guide with the advantages of the electronic medium, *Learning Biological Psychology* offers a wealth of comprehensive study material.

The CD includes (see the front endpapers for more):

- Chapter outline organizational structure
- Comprehensive interactive study questions
- Animated tutorials and activities
- Essay questions
- Terminology quizzes
- Multiple-choice quizzes
- Complete glossary

Biological Psychology NewsLink (www.biopsychology.com)

Available free to all users, this website is an invaluable resource for current news articles in the field. Updated daily, the site links to thousands of news items from a wide variety of sources, all referenced to textbook chapters and keywords.

For the Instructor

The following supplements are available to qualified adopters of the textbook.

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- PowerPoint presentations of all textbook figures and tables
- All the animations from the student CD
- Videos with accompanying notes
- Electronic version of the Instructor's Manual & Test Bank (PDF format)
- Computerized test bank using Brownstone's Diploma software (included)

Instructor's Manual & Test Bank (ISBN 0-87893-716-1)

Raymond Kesner and David Vago, *University of Utah*
The Instructor's Manual includes the following for each chapter of the textbook: Chapter Overview, Chapter Outline, Key Concepts, Lecture Outline, and References. The Test Bank includes over 2,100 questions of the following types: essay/discussion, multiple choice, fill-in-the-blank, matching, term definition, and paragraph development.

Overhead Transparencies (ISBN 0-87893-718-8)

This set includes 125 figures (approximately 175 transparencies), selected from throughout the textbook for teaching purposes. These are relabeled and optimized for projection in class.

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