

The background is an abstract composition of various textures and colors. It features broad, horizontal brushstrokes in shades of orange, yellow, and white. A large, dark green area is visible in the center, with two dark, hand-drawn triangles overlaid on it. A thin, bright blue line curves across the middle, and another blue line is visible in the lower left. The overall effect is that of a layered, artistic drawing or painting.

Neil R. Carlson

FOUNDATIONS OF  
Physiological  
Psychology

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# ***Foundations of Physiological Psychology***

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with the special assistance of

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# ***Foundations of Physiological Psychology***

# Preface

All my life I have wanted to know how things work. When I was a boy I took apart alarm clocks, radios, my mother's sewing machine, and other interesting gadgets, to see what was inside. Much to my parents' relief, I outgrew that habit (or at least got better at putting things back together), but my curiosity is still with me. Since my college days, I have been trying to find out all I can about the workings of the most intricate piece of machinery that we know of: the human brain.

The field of neuroscience research is a very busy and productive one today. A large number of scientists are trying to understand the physiology of behavior, using more and more advanced methods, yielding more and more interesting results. Their findings provide me with much to write about. I admire their dedication and hard work, and I thank them for giving me something to say.

I wrote this book at the request of my colleagues who teach the course, and who wanted a briefer version of *Physiology of Behavior* with more emphasis on research related to humans. Those of you who are familiar with that book will recognize its parentage in this one. Both books cover the same topics, in roughly the same order. The first part of this book is concerned with foundations: the history of the field, the structure and functions of neurons, neuroanatomy, and psychopharmacology. The second part is concerned with inputs and outputs: the sensory systems and the motor system. The third part deals with what might be called "motivated" behavior: sleep, reproduction, ingestion, and aggression. The fourth part deals with learning and with verbal and nonverbal communication. The final part deals with neurological and mental disorders.

There are some important differences between this book and *Physiology of Behavior*. The text of this book is not simply a shorter and denser version of its predecessor. I retained the illustrative examples, especially those dealing with human disorders, and added explanations of phenomena to be sure that students without much background in biology could understand what I was saying. Although I have simplified some of the detailed explanations I have retained the important principles.

This book contains an expanded discussion of drugs, with a new section on physiological and behavioral causes of drug addiction. Research methods are covered in Chapter 1 along with history. Learning and memory are now covered in one chapter, which also contains a discussion of reinforcement. I have added more applied and clinical examples throughout the book, and I have written a new chapter on neurological disorders. Each chapter begins with a chapter outline, showing what topics are to follow, and the text of each chapter opens with a vignette, designed to show students that the topics in this book have important implications for humans. Interim summaries follow each major section, and provide useful reviews. When new terms are introduced, they are listed in the margin. Each chapter ends with a list of key concepts and suggested readings.

Trying to keep up with the rapid progress being made in neuroscience research poses a challenge for teachers and textbook writers. If a student simply memorizes what we believe at the time to be facts, he or she is left with knowledge that quickly becomes obsolete. In this book I have tried to give students enough background material and enough knowledge of basic physiological processes so that they can revise what they have learned when research provides us with new information.

Writing is a difficult, time-consuming endeavor, and I find that I am still learning how to do it well. If I have at least partly achieved what I set out to do, readers will find that they can understand what I have said and will remain interested in what they are reading. I agree with Graves and Hodge (1947), who say that “. . . good English is a matter not merely of grammar and syntax and vocabulary, but also of sense.” “Readability” is not to be determined by counting syllables in words or words in sentences; it is a function of the clarity of thought and expression.

I designed this text to be interesting and informative. I have endeavored to provide a solid foundation for further study. Those students who will not take subsequent courses in this or related fields should receive the satisfaction of a much better understanding of their own behavior. Also, they will have a greater appreciation for the forthcoming advances in medical practices related to disorders that affect a person's perception, mood, or behavior. I hope that students who carefully read this book will henceforth perceive human behavior in a new light.

---

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My wife and I have prepared a student workbook to accompany this text. A good understanding of the principles of physiological psychology requires active participation in the learning process, and the workbook should provide an excellent framework for guiding the student's study behavior.

I owe a special debt of gratitude to Jay Braun, of Arizona State University. Jay served as a special consultant, and contributed immensely to the development of this book. He made suggestions about the organization of the book and about each chapter. He read my successive drafts and made suggestions for improving them. He

tirelessly read and re-read the manuscript, managing to maintain his patience and good humor. He helped me to trim excess verbiage, to add interesting discussions, and to organize things more clearly.

I also want to thank the people at Allyn and Bacon. John-Paul Lenney, my editor, provided assistance, support, and encouragement and helped me gather comments and suggestions from colleagues who have read the book, and Peter Petraitis, my production editor, got things organized and kept them running smoothly. Leslie Galton, an editorial assistant, organized the file of letters granting permission to use photos and illustrations. Barbara Gracia, of Woodstock Publishers' Services, demonstrated her masterful skills of organization. Few people realize what a difficult, demanding, and time-consuming job it is to coordinate the production of a project such as this, with hundreds of illustrations, but I do, and I thank her for all she has done. Carol Beal was my copy editor. Her attention to detail uncovered inconsistencies in my terminology, awkwardness in my prose, and disjunctions in my logical discourse and gave me a chance to fix them before anyone else saw them in print. Mark Lefkowitz, medical illustrator; and Horvath and Cuthbertson, Illustrators, did a superb job on the art, as you can easily see.

I must also thank my family for their assistance. My daughter Kerstin read drafts of my chapters and helped me clarify my prose. My son Paul ran errands for me and patiently accepted that I was often busily engaged in reading or writing in my study. But even more important than this assistance was the moral support and encouragement that my family provided me.

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## TO THE READER: USING THIS BOOK

Before you begin reading the first chapter, I want to say a few things about the design of the book that may help you with your studies. I have tried to integrate the text and illustrations as closely as possible. In my experience, one of the most annoying aspects of reading some books is not knowing when to look at an illustration. When reading complicated material, I have found that sometimes I look at the figure too soon, before I have read enough to understand it, and sometimes I look at it too late and realize that I could have made more sense out of the text if I had just looked at the figure sooner. Furthermore, after looking at the illustration I often find it difficult to return to the place where I stopped reading. Therefore, in this book you will find the figure references in boldface italics (like this: **Figure 5.6**), which means "stop reading and look at the figure." I have placed these references in the locations I think will be optimal. If you look away from the text then, you will be assured that you will not be interrupting a line of reasoning in a crucial place and will not have to reread several sentences to get going again. You will find sections like this: "Figure 3.1 shows an alligator and a human. This alligator is certainly laid out in a linear fashion; we can draw a straight line that starts between its eyes and continues down the center of its spinal cord. (See **Figure 3.1.**)" This particular example is a trivial one and will give you no problems no matter when you look at the figure. But in other cases the material is more complex, and you will have less trouble if you know what to look for before you stop reading and examine the illustration.

You will notice that some words in the text are *italicized* while others are printed in **boldface**. Italics mean one of two things: either the word is being stressed for emphasis and is not a new term, or I am pointing out a new term that I do not think is necessary for you to learn. On the other hand, a word in boldface is a new term that you should try to learn. Most of the boldface terms in the text are part of the vocabulary of the

physiological psychologist. Often, they will be used again in a later chapter. As an aid to your studying, I have included a list of them in the margin of the page on which they first occur. Also, the end of the text contains a glossary, which provides definitions for important terms that are used throughout the book. In addition, a comprehensive index at the end of the book provides a list of terms and topics, with page references.

The physiology of behavior is a complex subject, and this book contains many concepts and descriptions of experiments that will be new to you. At the end of each major section I have included an *interim summary*, which provides a place for you to stop and think again about what you have just read, in order to make sure that you understand the direction the discussion has gone. The end of the chapter contains a list of key concepts, which summarizes the material covered. Taken together, these sections provide a detailed summary of the information introduced in the chapter. My students tell me that they review the interim summaries just before taking a test.

I hope that in reading this book you will come not only to learn more about the brain but also to appreciate it for the marvelous organ it is. The brain is wonderfully complex, and perhaps the most remarkable thing is that we are able to use it in our attempt to understand it.

While working on this book, I imagined myself talking with students, telling them interesting stories about the findings of clinicians and research scientists. I hope that the dialogue will continue. Please write to me and tell me what you like and dislike about the book. My address is: Department of Psychology, Tobin Hall, University of Massachusetts, Amherst, Massachusetts 01003. If you write to me, we can make the conversation a two-way exchange.



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***PART  
ONE***

***Foundations***







## CHAPTER 1

# The Origins and Methods of Physiological Psychology

### CHAPTER OUTLINE

#### Understanding Self-awareness: A Physiological Approach

- Blindsight
- Split Brains

#### Interim Summary

#### The Nature of Physiological Psychology

- The Goals of Research
- Biological Roots of Physiological Psychology
- Functionalism: Natural Selection and Evolution

#### Interim Summary

#### Methods of Physiological Psychology

- Experimental Ablation
- Study of the Living Human Brain
- Recording the Brain's Electrical Activity
- Electrical Stimulation of the Brain

#### Interim Summary

#### Key Concepts

#### Suggested Readings