FIFTH EDITION

FUNDAMENTALS OF COGNITIVE PSYCHOLOGY

HENRY C. ELLIS
R. REED HUNT

FIFTH EDITION

FUNDAMENTALS OF COGNITIVE PSYCHOLOGY

HENRY C. ELLIS
University of New Mexico

R. REED HUNT
University of North Carolina

Boston, Massachusetts Burr Ridge, Illinois Dubuque, Iowa
Madison, Wisconsin New York, New York San Francisco, California St. Louis, Missouri

McGraw-Hill

A Division of The McGraw-Hill Companies

Book Team

Editor *Michael Lange*
Developmental Editor *Sheralee Connors*
Production Editor *Kay Driscoll*
Visuals/Design Developmental Consultant *Marilyn A. Phelps*
Visuals/Design Freelance Specialist *Mary L. Christianson*
Publishing Services Specialist *Sherry Padden*
Marketing Manager *Steven Yetter*
Advertising Manager *Jodi Rymer*

Vice President and General Manager *Thomas E. Doran*
Editor in Chief *Edgar J. Laube*
Executive Editor *Ed Bartell*
Executive Editor *Stan Stoga*
National Sales Manager *Eric Ziegler*
Director of CourseResource *Kathy Law Laube*
Director of CourseSystems *Chris Rogers*
Director of Marketing *Sue Simon*
Director of Production *Vickie Putman Caughron*
Imaging Group Manager *Chuck Carpenter*
Manager of Visuals and Design *Faye M. Schilling*
Design Manager *Jac Tilton*
Art Manager *Janice Roerig*
Permissions/Records Manager *Connie Allendorf*

Chairman Emeritus *Wm. C. Brown*
Chairman and Chief Executive Officer *Mark C. Falb*
President and Chief Operating Officer *G. Franklin Lewis*
Corporate Vice President, President of WCB Manufacturing *Roger Meyer*

Cover design by Elaine G. Allen

Copyedited by Patricia Stevens

Consulting Editor Frank A. Logan

Library of Congress Catalog Card Number: 92–70665

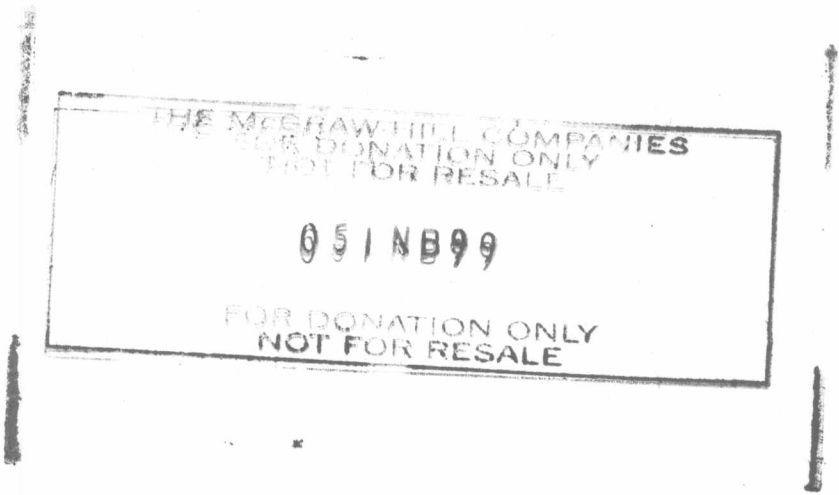
ISBN 0–697–10543–1

Printed in the United States of America

10 9 8 7

This book is dedicated to my wife, Florence, and to our children, Joan, Diane, and John Ellis

and to my parents, Nancy and Robert Hunt



PREFACE

In this fifth edition of *Fundamentals of Cognitive Psychology* we have added many new topics, describing recent exciting developments in cognitive psychology while retaining the general objectives of prior editions. Users of the previous edition will recognize a slight name change from *Fundamentals of Human Memory and Cognition* to the present title, which more succinctly describes our book. We are gratified that many people found the previous edition a useful and enjoyable text and comments from faculty and students continue to reinforce our efforts in writing this text. Because of positive comments and reviews, we have retained the general organization of the fourth edition, while adding many new topics to keep the book timely.

The purpose of this book is to introduce the substantive fundamental issues of cognitive psychology. It is written with the conviction that students can be introduced to cognitive psychology so that its fundamental principles are revealed in bold relief. We want to portray cognitive psychology as an exciting, problem-solving enterprise which will engage and stimulate students. To accomplish these objectives, we have chosen to discuss basic conceptual issues in detail, believing that the reporting of data makes little sense unless the problems and issues are clear. We think this approach is very important in introductory cognitive psychology where, in many cases, the conceptual issues tend to be very abstract. Empirical work, however, is thoroughly covered. Our approach is to discuss in depth selected experiments and their implications for the conceptual issues rather than attempt an exhaustive survey of the empirical literature. Again, we have found this approach to be effective when introducing students to cognitive psychology. Detailed discussion of selected experiments allows students to appreciate the intricacies of problem-solving activity in cognitive psychology. We also think students can more readily grasp the relationship between theory and data if given extensive discussion of a few experiments rather than overwhelmed with a large amount of data. Following such an introduction, students should have a firm foundation on which to build additional knowledge and understanding in advanced courses.

The book is also written with the belief that the principles of cognitive psychology should be introduced in such a way that students see their direct pertinence to and potential impact upon human affairs. Illustrations and

practical applications are liberally provided, with the hope that students will gain a fuller and richer understanding of the principles as they relate them to their personal experiences. These illustrations cannot, of course, perfectly reflect principles derived from laboratory settings, but they can approximate them, and thus, we hope, lead students to think of other illustrations as well as of potential exceptions.

This book is aimed principally at the undergraduate who is taking a basic course in Cognitive Psychology, in Memory and Cognition, or in Human Memory. It would also be appropriate as a text in an introductory graduate course when the students lack a background in Cognitive Psychology or Memory. Supplementary readings can be assigned by instructors who want more detail on specific topics. The book is written so that certain chapters can be omitted without disrupting the flow of topics. In this sense, the chapters can "stand alone"; however, interconnections among the chapters are made but can be understood by the prevailing context in each chapter. Finally, the text is written for the typical one-semester or one-quarter course.

This book can be used flexibly by instructors who wish to use certain portions of it and not others. For example, if an instructor teaches a comprehensive survey of Cognitive Psychology, all chapters would be appropriate. In contrast other combinations are possible. Here are a few of the possibilities:

	Chapters
Comprehensive Cognitive Survey	1–12
Memory Survey	1, 3–7, 9
Basic Cognition	1–8
Cognition Without Language and Comprehension	1–8, 10, 12

Chapter Title

1. Introduction to Cognitive Psychology
2. Sensory Register and Pattern Recognition
3. Attention
4. Short-Term, Working Memory
5. Encoding in Long-Term Memory
6. Retrieval Processes
7. Semantic Memory
8. Categorization and Concepts
9. Comprehension and Knowledge
10. Problem Solving and Reasoning
11. Language
12. Cognition, Emotion, and Memory

We have attempted to retain a *balance* between core concepts in cognitive psychology and newer "cutting edge" materials. Over sixty new and expanded topics have been introduced in this edition while retaining the important basic findings of cognitive psychology. Fundamental findings continue to be presented; at the same time new work on important topics such as autobiographical memory (Bahrick, Neisser), eyewitness identification (Loftus, McCloskey), connectionism (McClelland & Rumelhart), implicit memory (Schacter, Graf, Jacoby, Nelson, Roediger), working memory (Baddeley), schema theory (Brewer, Graesser), problem solving and reasoning (Holyoak), mood and memory (Hertel, Seibert), flashbulb memories (Pillemer, Neisser), language (Grice, Levelt), relational and distinctive processing (Einstein, McDaniel), and reality monitoring (Johnson) are presented.

We should also note some of the teaching features of this book which we believe are important. We have, as in previous editions, adopted an informal, at times conversational, style of writing in order to capture student interest. After the first chapter, most chapters begin with a familiar story, example, or illustration that gets students to think about their mental processes. These familiar, real-world settings help students to understand new concepts and make the material interesting. Each chapter begins with an outline, recognizing the importance of themes, prior knowledge, or advance organizers in helping students to better understand the material. Each chapter also contains a summary that highlights its main features. Practice test questions (multiple-choice, true–false, and discussion) are presented at the end of each chapter, beginning with chapter 2. A handy glossary is also provided for those who need a quick refresher and an extensive bibliography is provided.

Each major chapter ends with a set of examination items and explanatory answers. Students may use these items not only for review, but also for feedback in gauging their comprehension of the material. This, however, is not their only purpose, for we hope that the test items will stimulate students to raise new questions and to engage in additional thinking about the issues. Some of the questions are relatively straightforward, whereas others present issues from a somewhat different perspective to encourage students to stretch their imagination.

At the end of the book the Glossary describes the major technical terms defined in this book. The definitions are brief and do not, of course, provide all of the potential meaning of the terms. The Glossary provides a convenient refresher for students, but should not be relied upon exclusively. The understanding of technical terms and concepts comes when students can *use* the terms in the appropriate context.

An *Instructors' Manual* that contains multiple choice questions keyed to each chapter is available for instructors. Instructors need to ask their local Wm. C. Brown sales representative for a copy.

The book is generally organized around the information-processing framework of human cognition. Here are the principal features of each chapter, including the major changes and additions for the fifth edition.

Chapter 1. Introduction to Cognitive Psychology

This chapter provides a general introduction to cognitive psychology beginning with an explanation of cognitive psychology and its objectives. This is followed by a brief history of cognitive psychology and a discussion of mental processes. The approach of cognitive psychology, using experimental methods to analyze mental processes, and using inferences to build theory, is next outlined. New material includes a discussion of the usefulness of mental models as well as their limitations. Finally, we discuss the necessity for cognitive psychology to go beyond the information processing approach, using newer more sophisticated programs, such as parallel distributed processing, to model mental processes.

Chapter 2. Sensory Register and Pattern Recognition

This chapter retains an organization similar to that in the previous edition but adds important new material. The chapter organization focuses on the major topics of functions and characteristics of the sensory register, visual and auditory sensory register including modality effects, reading disability, pattern recognition and memory, template theory, serial and parallel processing, preprocessing, analysis-by-synthesis, and connectionism and parallel distributed processing. Particular emphasis is given to new material on connectionism and neural networks. The connectionist approach, as well as the assumptions underlying parallel distributed processing, is illustrated using McClelland and Rumelhart's theory of pattern recognition.

Chapter 3. Attention

The attention chapter contains a discussion of important topics including attention and consciousness, attention and pattern recognition, filter models of attention including the classic switch model and later attenuator models, late-selection filter models, capacity models of attention, secondary task procedure, and automatic processing, including automaticity and reading and the development of automaticity. The attention chapter was extensively revised in the previous edition so only minor changes were made here.

Chapter 4. Short-Term, Working Memory

This chapter provides a review of short-term memory research and theory and updates the topic with newer developments in working memory. The concept of working memory as developed by Baddeley is fully outlined, including its relation to capacity models of attention. The working memory subsystems of an articulatory loop and a visuospatial sketchpad are described and illustrated; and working memory is contrasted with earlier views of short-term memory. Studies of STM with amnesic patients are also described. Finally, the levels of processing approach is introduced as an alternative to earlier stage models of memory.

Chapter 5. Encoding in Long-Term Memory

This chapter provides a discussion of the major topics in encoding and long-term memory and begins with the issues of memory permanence and autobiographical memory, including Bahrick's now classic studies of people's memory for high school classmates. Problems with the levels of processing approach are described including revisions involving elaboration and distinctiveness. New material on organization, relational and distinctive processing, memory for personally relevant information, the generation effect, aging and memory, imagery, and neuropsychological studies of memory, including brain scanning, are introduced.

Chapter 6. Retrieval Processes

This chapter provides an overview of memory systems, retrieval mechanisms, implicit memory, forgetting, and state dependent effects. New in this chapter is an extensive discussion of memory systems including procedural and propositional subsystems of semantic memory. A thorough description of the new and exciting developments in implicit memory is provided, including a discussion of the significance of dissociations between direct and indirect tests of memory; included is Jacoby's work on perceptual identification. Two general theoretical explanations of memory dissociations are described: memory systems explanations and processing accounts. The importance of conceptually-driven and data-driven processes, as described by Roediger and others, is discussed. Finally, the importance of automatic vs. controlled processes in retrieval is reviewed.

Chapter 7. Semantic Memory

This chapter describes the role of knowledge in governing our actions, the task of describing semantic memory, and theories of semantic memory. In addition it describes semantic memory and its relation to pattern recognition and attention, semantic and episodic memory distinctions, implicit memory, and knowledge acquisition. Implications for separate semantic memory systems stemming from implicit memory research are discussed, including the important work of Mitchell, Brown, and Murphy. The chapter ends with a new discussion of knowledge representation issues.

Chapter 8. Categorization and Concepts

This chapter contains a description of types of concepts, the importance of natural concepts, the variety of categories, theories of categorization, and practical principles in forming concepts. A major new section on theories of categorization is introduced, including attribute, prototype, and exemplar theory. Priming and context effects in categorization are discussed, including the role of inductive inferences in categorization. The role of linguistic factors in forming categories, perceptual and semantic categories, family resemblances and basic-level categories is described. Finally, the material on traditional concept identification studies has been substantially reduced. This chapter has been moved so that it immediately follows the chapter on semantic memory in order that related issues are more easily seen by the student.

Chapter 9. Comprehension and Knowledge

This chapter retains its broad coverage of major topics in comprehension. The chapter has principal sections on integration and themes in comprehension, presuppositions and inferences, locus of constructive processes, schemas in comprehension and memory, schema theory, and prior knowledge and text processing. New material includes the role of presuppositions in eyewitness testimony, response bias and memory integration interpretations of eyewitness testimony research, including Loftus' and McCloskey's views, developments in schema theory including Brewer's and Graesser's theoretical approaches, and a useful student-oriented summary of schema theory. Finally, the role of knowledge in priming effects and reading comprehension is discussed.

Chapter 10. Problem Solving and Reasoning

This chapter provides the range of topics typical of research and theory on problem solving and reasoning. The importance of mental representation, stages in problem solving, processes in problem solving, practical tips on problem solving, theories of problem solving, and major issues in reasoning are discussed. Seven new topics are introduced in this chapter: creativity and evaluation, brainstorming and creativity, ill-defined problems, experts and novices, analogical reasoning, problem solving in the classroom, and reasoning errors.

Chapter 11. Language

The language chapter contains the same general structure as in the previous edition with four major sections dealing with the function of language, the structure of language, processes in language, and issues in language. However, it has undergone a thorough revision and updating including removal of some of the older topics. Important new material is found in the topics of speech acts and intentions, fuzzy boundaries in language and the role of word meaning, context and language, language production and Grice's maxims, and language and the brain, including brain disorders such as aphasia.

Chapter 12. Cognition, Emotion, and Memory

This chapter has the same general structure as in the previous edition but has a number of new topics. The chapter is organized around four main issues: the importance of cognition and emotion, experimental findings in mood and memory, theoretical interpretations, and specific issues in emotion and cognition. New topics in the chapter include research on the importance of focused attention in eliminating depressive deficits in memory, the role of irrelevant thoughts in explaining mood and memory effects, the role of emotional states in eyewitness testimony, flashbulb memory, personal memories, and anxiety and performance.

ACKNOWLEDGMENTS

We are indebted to many persons in the preparation of the fifth edition of *Fundamentals of Cognitive Psychology.* We wish to thank the following individuals who either carefully reviewed the fifth edition or who made very helpful suggestions in preparing the fifth edition. We especially thank Paul Amrhein who assisted us in the revision of the language chapter:

Paul Amrhein, *University of New Mexico*
Jane Ann Ausley, *University of North Carolina*
Gilles Einstein, *Furman University*
Paul Foos, *Florida International University*
Danalee Goldthwaite, *Cariboo College*
David Gorfein, *Adelphi University*
Paula Hertel, *Trinity University*
David Horton, *University of Maryland*
Stanley Klein, *University of California, Santa Barbara*
David Mitchell, *Southern Methodist University*
Douglas Nelson, *University of South Florida*
Roddy Roediger, *Rice University*
Pennie Seibert, *Boise State University*
Jeff Toth, *McMaster University*

In addition, we wish to thank the following individuals who have provided either useful feedback regarding previous editions, or who have thoroughly reviewed one of the previous editions or one or more chapters. We continue to appreciate all of their earlier suggestions.

Paul Amrhein, *University of New Mexico*
Janet Andrews, *Vassar College*
Jane Ann Ausley, *University of North Carolina*
Bernard Barrs, *SUNY, Stony Brook*
Brian Babbitt, *Missouri Southern College*

Charles Brewer, *Furman University*
Bruce Britton, *University of Georgia*
Fergus Craik, *University of Toronto*
Robert Crowder, *Yale University*
Tony DeCasper, *University of North Carolina*
Terry Daniel, *University of Arizona*
Harold Delaney, *University of New Mexico*
Gilles Einstein, *Furman University*
Paul Foos, *Florida International University*
William Gordon, *University of New Mexico*
Paula Hertel, *Trinity University*
Marcia Johnson, *Princeton University*
Peder Johnson, *University of New Mexico*
William Johnston, *University of Utah*
Joseph LaVoie, *University of Nebraska*
Leah Light, *Pitzer College*
Cheryl Logan, *University of North Carolina*
Frank Logan, *University of New Mexico*
Ruth Maki, *North Dakota State University*
Marc Marschark, *University of North Carolina*
David Mitchell, *Southern Methodist University*
John Mueller, *University of Missouri*
Jean Newman, *University of New Mexico*
Marcia Ozier, *Dalhousie University*
Frederick Parenté, *Towson State University*
James Pate, *Georgia State University*
Stan Parkinson, *Arizona State University*
Michael Scavio, *California State University, Fullerton*
Steven Schmidt, *Virginia Polytechnic Institute and State University*
Ronald Shaffer, *Western Washington University*
Blair Stone, *University of Utah*
Sherman Tyler, *University of Pittsburgh,* and
Eugene Winograd, *Emory University*

The people at Brown and Benchmark provided superb support and assistance throughout this project. We were especially fortunate in having the support and cooperation of a first-rate staff who were also encouraging and enthusiastic. We especially thank Ann Schaffer and Sheralee Connors, our editors, who have done everything possible to make our association with Brown and Benchmark Publishers an enjoyable experience. We also thank Kay Driscoll, production editor, who oversaw the complex job of getting the book through production and handled all of the numerous details that arose in this job. We thank Carla Aspelmeier, product manager, who did a superior job in preparing materials, and Michael Lange, senior editor, whose help was always available.

The secretarial staffs at the University of New Mexico and the University of North Carolina not only contributed their word-processing expertise but also gave us frequent words of encouragement. We are especially grateful to Mary Hungate, department editor, University of New Mexico and Rosemarie Andrews and Grace Martin, secretaries at North Carolina, for their help. Their skill and patience are most appreciated. Finally, we thank the students in our cognitive psychology classes who read and commented on earlier drafts of the manuscript.

CONTENTS