HUMAN MEMORY AND COGNITION

MARK H. ASHCRAFT

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To the three who matter most:

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Preface

The field of memory and cognition is fascinating, dealing with questions and ideas that have an inherent appeal (how we think, reason, remember, and use language, for instance). Conversations among cognitive psychologists at the Psychonomic Society meetings, for example, are agitated, intense, and full of energy. Despite this enthusiasm, however, our undergraduate texts often portray the field as rather dull. Students see cognitive psychology as overly concerned with the minutiae of experimental method and technical jargon, and not concerned enough with the interesting issues. While not slighting the empirical foundation of the field, I have tried to capture some of the excitement of the area, so that students not only will understand the material, but also will appreciate cognitive psychology as one of the more interesting topics of their student careers. I have taken an approach that stresses explanation and understanding over mere cataloging of experiments and tasks. I have attempted to engage students' intuitive understanding, where appropriate, by including examples and demonstrations. To help students hurdle the "jargon problem," critical terms included in the glossary are boldfaced and defined immediately in italicized print. Along with the glossary, this attention to terminology should help students acquire the specialized vocabulary that is necessary to a complete understanding of the field.

A second dimension of dullness that I have attempted to avoid is one of writing style. I have quite intentionally adopted a more colloquial style than is customary in the field (or in texts in general), beginning each chapter with a pertinent, often humorous anecdote, using the first person, posing direct questions to the reader, inserting parenthetical commentary, and so forth. My own students have told me that these features make the book more approachable; one said "It's interesting—not like a textbook," which I took as a compliment. This occasionally informal style runs the risk of putting off those instructors who expect a more formal, detached presentation, of course. Yet I would rather have students read and remember the material than have them cope with a book their instructors selected because of a carefully pedantic style. There's plenty of time to deal with the latter in graduate school.

The book is directed primarily at the 300–400 level undergraduate who is taking a basic course in Memory and Cognition, although I suspect it would also be appropriate as a survey text in an introductory graduate course when first-year students lack an undergraduate background in memory and cognition (supplementary readings are suggested at the end

of each chapter). At my university, the typical quarter contains 10 weeks of instruction, sufficient to cover all but about two or three of the chapters. I have organized the book so that an instructor can either omit certain chapters, because of time or interest constraints, or omit distinct sections of the chapters. Some may have a curriculum that covers language extensively in other courses, and would want to omit chapters 8 through 10, whereas others may view the material in chapters 11 through 13, on decision making, problem solving, and current directions, as less central to their coverage of cognitive psychology. Below are five groupings of the chapters, along with the chapter titles, that suggest appropriate reading assignments for courses tailored to one or another focus within the field of cognitive psychology.

Chapter Titles	Suggested Groupings
1. Cognitive Psychology: An Introduction	Cognitive Survey: 1–4, 6, 7, 9, 11–13
2. The Human Information Processing System	
3. Perception and Attention	
4. Short-term, Working Memory	Memory Survey: 1–9, 11
5. Episodic Long-term Memory	
6. Semantic Long-term Memory	
7. Integrating Semantic and Episodic Memory	Cognition with Language: 1–3, 6–10, 12, 13
8. Language	
9. Comprehension: Language and Semantics Together	
10. Language Development	
11. Decisions and Reasoning	Cognition without Language: 1–7, 11–13
12. Problem Solving	
13. Current Directions:	
Cognitive Science	Cognitive Science: 1–3, 6–9, 11–13
Neurocognition	
Applied Cognition	

While the book is written so that certain chapters may be omitted without seriously disrupting the continuity of topics, I have not forced the chapters to "stand alone" completely. In my view, the distinct disadvantage to such an approach is that the interconnections among topics are slighted. When I refer to a discussion elsewhere in the book, I have either provided enough information so that the interconnection is obvious, or have referred to the specific section in the other chapter that a student might want to review quickly.

Finally, I have attempted to balance two issues that enter into an instructor's adoption decision, coverage of "basic" or core material and coverage of "cutting edge" topics. I would not select a book that failed to

discuss research by Sperling and Sternberg, for example, however such contributions may eventually be viewed. On the other hand, I also prefer a book that includes Bahrick's autobiographical memory research, McCloskey's work on naive physics, and Neisser's thoughts on ecological validity, to pick just three examples. The book covers both kinds of material. When a current debate or area of research is not described in the primary text, I have at least covered it briefly in the Suggested Readings or in a footnote.

I hope that the balance I have struck between covering classic research and current topics, the style I have adopted, and the relatively standard organization I have used will make the text easy to teach from, and easy for students to read and remember. More importantly, I hope that my portrayal of the field of cognitive psychology will be viewed as useful in the education of our students. I would be delighted to receive the comments and suggestions of those who use this book, instructors and students alike. Write in care of the Psychology Department, Cleveland State University, Cleveland, OH 44115 (BITNET address: RØ599@CSUOHIO).

▼ Acknowledgments

At some point during my work on this project, it occurred to me that writing a book is similar in many respects to riding a roller coaster. You decide to ride it voluntarily, there are lots of ups and downs, most of them unexpected, the ride lasts about twice as long as you want it to, and you alternate between having a good time and wishing you'd never gotten on in the first place. Many individuals went along for the ride as I wrote the book, and several of them deserve special thanks. Jane Sudbrink and Denise Workman were instrumental in getting the project off the ground and supervising the early stages of writing. Rebecca Strehlow provided invaluable assistance during the revision phase, and knew exactly when to cajole, plead, or reason with me. Jean Dal Porto has guided the revised manuscript into print in a thoroughly expert fashion, managing to maintain a welcome attitude of helpfulness and calm throughout. Expert reviews by R. Reed Hunt, University of North Carolina-Greensboro; John Jonides, University of Michigan; Michael Masson, University of Victoria; James S. Nairne, University of Texas-Arlington; and especially Gregory B. Simpson, University of Nebraska-Omaha, provided important professional advice on all aspects of the draft manuscript. Some "local" sources of support also deserve mention as well. Several of my undergraduate classes coped uncomplainingly with bulky, somewhat incomplete photocopied versions of the manuscript; their suggestions and comments have made the book easier to study. My colleague Marjorie Reed was available on a moment's notice for a quick "cognitive consultation," as well as for

words of encouragement when necessary. Trenton Grale and Joan Roemer performed time-saving library and permissions work, and Mike Faust provided friendly assistance with chores ranging from cutting and pasting to reading and critiquing. Finally, I wish to thank my wife and children for putting up with a husband and father who was too frequently "at the office," and usually preoccupied when he was at home. In gratitude for their support and tolerance, I dedicate this book to them.

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Chapter 1

COGNITIVE PSYCHOLOGY: AN INTRODUCTION

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▼ Cognitive Psychology and Information Processing: The New Direction

The Assumptions of Cognitive Psychology
Mental Processes Exist
Active Information Processors
Time and Accuracy Measures

What a piece of work is man. How noble in reason! How infinite in faculty! In form and moving how express and admirable! In action how like an angel! In apprehension, how like a god! (Act 2, scene 2, of Shakespeare's Hamlet)[1]

One difficulty in the psychological sciences lies in the familiarity of the phenomena with which they deal. A certain intellectual effort is required to see how such phenomena can pose serious problems or call for intricate explanatory theories. One is inclined to take them for granted as necessary or somehow "natural." (Chomsky, 1968, p. 24)

It can be very difficult to appreciate just how complex human cognition really is, because so much of what we call cognition is so ordinary and commonplace. I've certainly not had much success at impressing my own son with it. When he was three, we stayed overnight with some friends who had a swimming pool in their backyard—a big attraction to a three-year-old boy, of course. Many months later, long after he had stopped talking about the visit, he brought the topic up again, quite unexpectedly. His remembering the event struck me at the time as an obvious, early, and deliberate cognitive act. Being a proud father and a cognitive psychologist, I made a point of stressing how terrific his recollection was, saying, "Jordan, that's really great! You're *remembering* things, you're thinking about them, you're using your memory." His reaction to this was succinct—he shrugged and walked away, as if to say "Yeah, no big deal." But of course it is a big deal. Our infinite mental faculties are no less interesting because they are routine, or because we take them for granted. But it certainly can be hard to convince someone of this.

This book is about human memory and cognition, and specifically about the scientific study of human memory and cognition. We need a quick definition to get us started. For the moment, consider the topic of this book to be *the mental events and knowledge used in activities like recognizing an object, remembering a name, having an idea, understanding a sentence, and solving a problem.* In this book, we will consider a very broad range of subjects, from basic perception through complex decision making, from seemingly simple mental acts such as recognizing a letter of the alphabet to very complicated acts such as participating in a conversation. How do we read for meaning? How do we memorize facts? What does it mean to "forget" something? Do we reason out the answers to questions in a logical fashion? How do we know that we don't know something? The unifying theme behind all of this is one of the most fascinating and important questions of all time—How do people think?

[1]Unlike Shakespeare, modern writers have been sensitized to the sexist bias implied by the generic terms *man, he,* and so forth. I have attempted in this book to avoid such usage whenever possible. On those stylistic occasions where the generic term couldn't be avoided, or when I simply grew tired of the plural or collective terms, I have tried to alternate between the generic *he* and *she,* on a section-by-section basis.

Notice right away that we are interested in a scientific approach to human memory and thought. This places us in the branch of modern psychology usually labeled *cognitive psychology*. To a very large extent, cognitive psychology is an empirical field, a field built on the results of experiments and the explanations of models and theories. We will be dealing with many of these experiments, explaining why they were done, what sorts of questions they answer, what directions they suggest for future studies, and so forth. By contrast, this book does not deal with nonempirical or philosophical approaches to the human mind. It is true, of course, that philosophy has had a profound influence on psychology—indeed, psychology began as an offshoot of philosophy. And, it is obviously true that all of us, cognitive psychologists included, have been shaped and influenced by our culture and intellectual history in countless ways. Nonetheless, the discipline of psychology has largely accepted that body of work concerned with scientific approaches to the world; the purely philosophical approaches are viewed rather skeptically. Thus, one of the central characteristics of modern cognitive psychology is its allegiance to objective, empirical methods of investigation—this is one of the shiniest badges we wear. For reasons discussed below, cognitive psychology maintains an arm's-length distance from subjective, "armchair" explanations of the nature of thought. We are experimentalists, and this is the approach you'll read about in this book.

A few of you, having read the previous paragraph, may be thinking "Well, that's the bad news. Now, where's the good news?" Here it is: within the boundaries of objective scientific methods, cognitive psychology is asking a whole host of fascinating questions. Since the beginnings of modern cognitive psychology some 30 to 35 years ago, there has been a true explosion of interest in cognition, and in the "cognitive approach" to human behavior and thought. Questions that had been on psychology's back burner for too long, such as "How do we read" or "How do we use language," have become active areas of investigation. The pent-up interest in these questions, unleashed during the "cognitive revolution" of the late 1950s, has yielded tremendous progress.

The most basic purpose of this book is to tell you what has been discovered about human memory and cognitive processes and to share cognitive psychology's conclusions and insights about that particularly human activity called thought. The most highly sophisticated, flexible, and efficient "computer" available today is your memory, with its collection of mental processes. How does it work? As amazing as electronic computers are, their capabilities are literally kid stuff compared to what you routinely do in even a single minute's worth of thinking. The need to understand ourselves is basic, and this includes an understanding of how our own mental apparatus operates. While this book is not an owner's manual, it does nonetheless describe and explain what is known about the psychological functioning of the human mind.

Another purpose of this book is to describe how cognitive psychology has made these discoveries. Your appreciation of the information in this