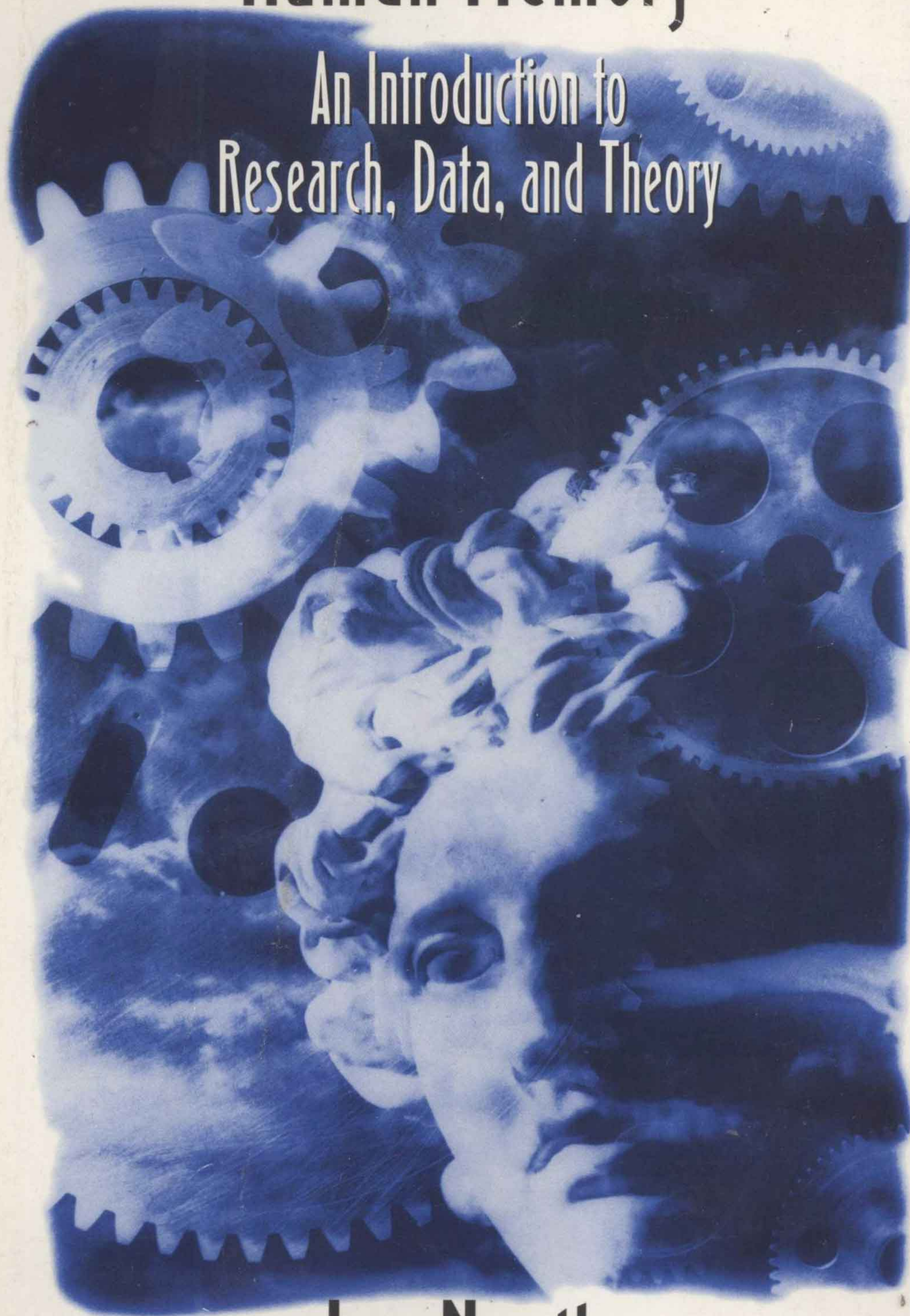


Human Memory

An Introduction to
Research, Data, and Theory



Ian Neath

HUMAN MEMORY

An Introduction to Research, Data, and Theory

Ian Neath
Purdue University



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To A. M. S.
and
R. T. G. *and* H. T. G.

Ian Neath is currently an associate professor in the Department of Psychological Sciences at Purdue University in West Lafayette, Indiana. He received a B.A. in history and psychology from Rice University in 1987 and a Ph.D. in cognitive psychology from Yale University in 1991. At Purdue, he regularly teaches both the undergraduate and graduate courses on human memory, as well as courses on introductory psychology, cognitive psychology, and simulation modeling. He has published many articles on memory in such professional journals as *Memory*, *Memory & Cognition*, *Learning & Memory*, and *The Journal of Memory and Language*. He has also authored or co-authored articles in *Animal Learning & Behavior*, *Psychonomic Bulletin & Review*, and *The Encyclopedia of Neuroscience*.

Preface

This book is designed for use in both upper-division undergraduate and lower-division graduate courses on human memory. I wrote it because there were no books on memory that were really appropriate for the courses that I teach at Purdue. For the undergraduate memory course, I used to use Zechmeister and Nyberg's *Human Memory* (1982), but it is out of date, and the authors, unfortunately, have not offered a revised edition. For the graduate course, I have assigned sections of both Crowder's *Principles of Learning and Memory* (1976) and Murdock's *Human Memory* (1974). These texts provide sophisticated and insightful analyses of many problems in memory, and even though they are more than 20 years old, they remain useful reference books. Other books typically suffer from one of two problems: either their scope is too limited for a full semester course on human memory (e.g., Greene, 1992), or their scope is too inclusive (e.g., Anderson, 1995), including material that at Purdue is covered by a separate course on animal learning. Thus, this book covers what I cover in my two courses—although not all of the material is used in both courses—and additional readings from primary sources are assigned in the graduate course.

There are two unusual features of this book. First, there is an emphasis on theory and models with an extended discussion of some of the major quantitative models of memory. I was surprised when I could find introductory cognitive books (a lower-level course) that cover SAM, but no memory text that included the model. Because of SAM's enormous influence, knowledge of SAM, as well as of the other global memory models, is essential for understanding much of the most recent research on memory. Another special feature of this text, following the lead of Zechmeister and Nyberg, is an emphasis on research. Each chapter (with the exception of the first chapter, the global memory models chapter, and the developmental chapter) features a classic or important experiment that students can easily conduct, and the Appendix contains all the stimuli necessary to conduct the experiments. Indeed, the many similarities between this book and that of Zechmeister and Nyberg are entirely intentional.

One major problem in a text such as this concerns the relationship between the experimental data reported by a researcher and the theoretical explanation. Often in this book I report data but offer a theory very different from that proposed by the original author(s), primarily because there are too many different theories to mention every single one. Although this is not a new problem (Underwood, 1972), there does appear to be a proliferation of theories (Watkins, 1984). As an example, I discuss the results of Keppel

and Underwood (1962), but I make no mention of their theoretical interpretation; similarly, I present Hyde and Jenkins (1973) as supporting levels of processing, whereas their interpretation was different. I never (to my knowledge) attribute a theoretical position to an author that is not clearly stated in the work, and I have tried to ensure that no unwarranted inferences will be drawn between a particular researcher and a particular theory. In addition, I often do not present the full experimental design when the complications in the original design might obscure the major point. For example, when discussing the Geric (1989) work that looks at the malleability of knowledge, I do not mention all of the conditions, such as the false versions and the control studies.

I have tried to achieve a balance between historically significant findings and current “state-of-the-art” research. One consequence of the former is that there are extensive references to memory research and theory during the early and middle parts of this century, including numerous references to people such as McGeoch, Postman, and Underwood. I was surprised to find that many memory textbooks include no citations to these (and many other) researchers whose ideas and work so profoundly affected the field. One consequence of including current work is that there are many equations in the book. Ideally, the equations will be a redundant restatement of the verbal description, but they have the advantage of being far more precise. None of the equations, however, require more mathematical ability than is needed for a basic statistics course.

Finally, there are many important topics that are not covered or that receive only minimal attention. The primary reason is that memory plays so central a role in cognitive functioning that almost all areas of experimental psychology could legitimately be included in a memory textbook. However, manuscripts are eventually due at the publishers, and I did not have time to include all of the topics that I would have liked. Hopefully, the book reflects a reasonably fair summary of the major areas of mainstream memory research.

A Guide to the Book

Each chapter in this book is, to a large extent, self-contained and can be read in any order. Several features help this modular design, including defining the same concept in more than one chapter and providing numerous cross-references to other chapters. Nonetheless, certain groups of chapters will be easier to understand if read in sequence: Chapters 6, 7, and 8 should be read in order, and Chapter 10 should be read before Chapter 11. Chapter 17, on the other hand, can serve as either a review or as an introduction.

Chapter 2 situates current research within a larger historical perspective. Included is a brief overview of the contribution of philosophy to psychology’s early history, as well as a discussion of the pioneering work of Hermann Ebbinghaus. The experiment replicates Ebbinghaus’s famous forgetting function. The associationist tradition in memory that grew out of this early work is presented in some detail, with an emphasis on how it influenced research in the early and middle parts of the 20th century and served as the basis of connectionism.

Chapter 3 reviews work on sensory memory with an emphasis on whether there is evidence to support the idea that there exist separate memory systems for sensory information. Most of the chapter concerns visual and auditory modalities, but there is also a

brief discussion of memory for odors, a sensory modality that has been rather understudied. The experiment focuses on the stimulus suffix effect.

Chapter 4 presents the common multistore, or modal, model of memory, with an in-depth examination of the evidence used to support a distinction between short-term store and long-term store. The chapter also discusses in some detail the classic work of Broadbent, Miller, Peterson and Peterson, Waugh and Norman, and Atkinson and Shiffrin, and includes a critical examination of the strengths and weakness of this approach. The experiment compares short-term recency effects with long-term recency effects.

Chapter 5 compares three current perspectives of immediate memory, Baddeley's (1986) Working Memory, Cowan's (1995) activation view, and Nairne's (1990) Feature Model. All of these views are presented in some detail to illustrate how theorists explain the huge amount of information we have about memory performance. The experiment demonstrates the word-length effect — better recall of short compared to long words.

Whereas Chapters 3 and 4 focus on structures, Chapter 6 focuses on processing, including both levels of processing and transfer appropriate processing. The relationship between the processing performed at study and the processing required at test is examined in detail, and the chapter concludes with presentation of Jacoby's (1991) processing dissociation framework, a technique designed to evaluate the contributions of different processes. The experiment in Chapter 6 illustrates the basic idea between levels of processing. These ideas lead into Chapter 7, which looks at three main views of forgetting, consolidation, decay, and interference. Here, the experiment examines the release from proactive interference effect seen in the Brown-Peterson paradigm.

Chapter 8 looks at implicit and explicit memory, particularly as they bear on the important issue of whether there are multiple memory systems. The experiment is a demonstration of repetition priming, the data most often used to support a distinction between implicit and explicit memory. The chapter compares the multiple systems view of Schacter and Tulving (1994), the transfer appropriate processing view of Roediger (1990), and the bias interpretation of Ratcliff and McKoon (1996).

Chapter 9 completes the discussion of multiple memory systems by presenting an overview of the biological bases of memory, including a discussion of simple neural circuits and a summary of methods of investigation. The experiment illustrates a simple behavioral measure for examining underlying neurological structure. Following this, there is a survey of research on amnesia.

Chapter 10 examines recognition memory, including a discussion of signal detection theory and how this can be used to assess discrimination and estimate response bias. The experiment details how to apply a signal detection analysis to recognition data, including a manipulation of response bias. Two early views, HAM and the class of generate-recognize models, are discussed, as well as more recent accounts. Also included are discussions of the remember-know paradigm, the mirror effect, and an overview of face recognition.

Chapter 11 presents three so-called global memory models. These models, SAM, MINERVA 2, and TODAM, are described in some detail and provide an illustration of how sophisticated current theories of memory can be. Each model can account for recognition and at least one other paradigm: for example, free recall for SAM, serial recall for TODAM, and schema abstraction for MINERVA 2. There is also an example of a connectionist model of memory, in this case a nonlinear back propagation model of recognition.

Chapters 12 and 13 examine the issue of representation. Chapter 12 focuses on knowledge and thus emphasizes a primarily propositional form of representation. The chapter includes both spreading activation accounts of semantic priming as well as the current compound cue theories, which extend the global memory models presented in the previous chapter. The experiment in this chapter examines typicality effects in categorization. Chapter 13 concentrates on visual imagery, arguing for the need for an analog form of representation. This chapter includes the early work of Paivio and Brooks, as well as the more recent work of Kosslyn and Shepard. Chapter 13 also discusses the issue of reality monitoring, including the Perky effect showing the difficulty in distinguishing between real and imaged stimuli. The experiment examines a prediction of Paivo's dual-coding theory, and the chapter concludes with a brief discussion of auditory and odor imagery.

Chapter 14 presents an overview of memory for "when," including a discussion of how people remember when particular events occurred, a section on autobiographical memory, and a comparison of various theories of dating events. Two models are compared in some detail, with an emphasis on how they account for both laboratory and real world data. The experiment assesses memory for when items were presented, which illustrates many of the same properties as memory for autobiographical events.

Chapter 15 concentrates on reconstructive processes in memory, including the role of schemas and general knowledge. The chapter includes a suggestion for making the concept of a schema less vague and capable of making predictions, and it presents a detailed presentation of memory illusions. Chapter 15 also explores the consequences of reconstructive memory for evaluating the memory of eyewitnesses, including the role of misinformation, hypnosis, and the cognitive interview and how factors such as emotion and arousal can affect accuracy. The experiment illustrates the phenomenon of memory for words not presented, and the chapter includes a discussion of implanting memories.

Chapter 16 looks at developmental issues, emphasizing qualitative differences in processing when infants, children and healthy older adults are compared to college students. Because of the difficulty of recruiting appropriate subjects, this chapter has no experiment.

Chapter 17 discusses ways to improve memory. Unlike books that focus only on the technical mnemonics, this chapter includes a much broader treatment and can serve as either a review or an introduction. The experiment duplicates a classic finding of better retention following interactive imagery as compared to no imagery. In addition, the chapter provides a critique of popular books, separating the useful and scientifically supported techniques from the useless and disproven.

Instructor Support

To assist the teacher or student, I have created several demos that implement each of the major global memory models in Chapter 11 (SAM, MINERVA 2, and TODAM) for both IBM-compatible (DOS and Windows) and Macintosh computers. There are also versions of the Feature Model (Chapter 5) and Perturbation Theory (Chapter 14). You may download these programs, and a set of explanatory notes and suggested exercises, through the World Wide Web:

<http://www.psych.purdue.edu/~neath/memory/memory.html>

I'd be interested in your feedback and suggestions on how these programs, or any other part of the book, might be improved for future editions.

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Professionally, I am particularly indebted to three people: my undergraduate advisor, Michael J. Watkins of Rice University; my graduate advisor, Robert G. Crowder of Yale University; and my colleague James S. Nairne, at Purdue. Mike got me interested in human memory, and because of him I went on to graduate school in cognitive psychology rather than in history. Bob was the perfect advisor for me, treating me as a colleague from the first day and letting me pursue and develop my interests under his direction. At Purdue, Jim has fostered my interest in simulation modeling and constantly challenges me to be rigorous and thorough in my own thinking.

Several reviewers read the entire manuscript, and many more read portions; each made numerous insightful and critical comments that have greatly improved the manuscript. They are: Harriett Amster, University of Texas, Arlington; Barbara H. Basden, California State University, Fresno; Robert Campbell, Clemson University; James M. Clark, University of Winnipeg; Tim Curran, Case Western Reserve University; Ira Fischler, University of Florida; Peter Graf, University of British Columbia; Robert Greene, Case Western Reserve University; Denny C. LeCompte, University of Missouri–St. Louis; Wendy V. Parr, Victoria University of Wellington; Henry L. Roediger III, Washington University; J. Scott Saults, University of Missouri–Columbia; Jennifer R. Shelton-Young, Harvard University; Michael A. Stadler, University of Missouri–Columbia.

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Aimée M. Surprenant read the entire book and has offered continuous support, advice, and encouragement from the beginning.

Finally, I am indebted to the many Purdue undergraduates who have taken Psyc 311, Human Memory, and have shown they can understand *all* the material included in the book if only I have high enough expectations.

Sapiens nihil affirmat quod non probat

Ian Neath

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