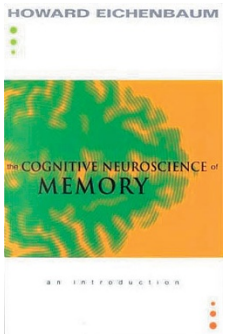
The four Cs of memory



The Cognitive Neuroscience of Memory: An Introduction

by Howard Eichenbaum
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Reviewed by Alcino J. Silva

The Cognitive Neuroscience of Memory: An Introduction by Howard Eichenbaum is a wonderful textbook for advanced undergraduate and graduate courses. This long-overdue, accessible summary of the main findings of a fast-evolving field is likely to influence students of memory for years to come. However, this insightful book is much more than a textbook; the structure and contents go well beyond a collection of didactic essays on the most influential cognitive neuroscience studies of memory. Instead, it is a highly personal and compelling narrative that reflects both the author's command of cognitive neuroscience and his unique perspective on its history and current directions. The book is an impressive combination of scholarship and accessibility. The author's elegant pen and mastery of the subject does justice to complex ideas, despite their tortuous historical precedents, yet does not sacrifice clarity. The book also has its share of subjective and controversial descriptions of key findings in the field. But that is exactly one of its charms: it is not a bland, soporific collection of essays that serves all without helping any. This is the kind of textbook that encourages the reader to think about key issues and ideas. The occasional controversial points will lead to interesting and animated class discussions, which will also be evoked by the insightful questions at the beginning of each chapter and a list of further readings. The author's deep respect for the history of ideas comes across in every chapter of the book, providing the reader with a deeper historical understanding of key ideas and concepts, which is more important than ever in this age of PubMed-induced retrograde amnesia.

In covering a topic as large and diverse as 'cognitive neuroscience of memory', it is important to have a framework that guides and orients the reader. Here the author has divided the vast subject matter of the book into four themes: connection, cognition, compartmentalization and consolidation (the 4 Cs). In the first theme, connection, the author explores the seminal idea that memories are stored as patterns of synaptic changes. Not surprisingly, the emphasis is on molecular and cellular cognition, studies of the components (channels, kinases, phosphatases, transcription factors) and mechanisms involved in information processing and storage in cells and networks. After an introduction to basic molecular and cellular terms, the author describes several cellular models of learning and memory, including habituation, sensitization and classical conditioning in *Aplysia*, and LTP in rodents. Overall, the book takes the student from molecules to mind with a clearly deep respect for the plethora of approaches that bridge this gap. However (and here I show my own bias), I wished the author had given a more comprehensive treatment to this subject. I can imagine similar complaints from my cognitive science, cognitive neuroscience and systems neuroscience colleagues about the chapters that describe their work. Nevertheless, the book succeeds in introducing students to this vastly complex topic, as it would be impossible to cram a comprehensive treatise of memory into either a book of this size or the schedule of most learning and memory courses.

The second theme, cognition, describes attempts both to structure the psychological basis of memory and to model cognition in animals. It starts with a lucid and engrossing description of the classical debate between behaviorism and cognitivism, important components of which have been incorporated in modern studies of memory; the reductionistic obsession for component analysis is easy to recognize in modern molecular and cellular cognition studies, whereas the globalistic approaches and views of cognitivists survive nearly untouched to this day. Of special interest in this section are the descriptions of studies of the famous patient HM, a cornerstone of modern neuroscience of memory. However, the author really shines when discussing his own field (rodent models of hippocampal function), one of the success stories of modern behavioral neuroscience.

In the next theme, compartmentalization, the author describes the history and intellectual structure of the current taxonomy of memory systems, including declarative, procedural and emotional memory. This section starts with an insightful essay on cortical memory, where the author describes both well-known and obscure studies of memory processing and storage in cortical networks. The broad discussion of memory systems starts with classical double-dissociation studies that helped to establish the current paradigm. I must confess that I have never read a better description of the now classical experiments of Packard and McGaugh or Knowlton and Squire on the dissociation of striatal and hippocampal memory.

The Cognitive Neuroscience of Memory: An Introduction ends with a wonderful chapter about the cellular and systems mechanisms of memory consolidation. To distinguish between cellular and systems versions of consolidation, the author proposes to use the term 'fixation' for the initial consolidation of memory requiring protein synthesis. The description of the consolidation of hippocampal-dependent memories in cortical networks is particularly lucid and illustrates another important facet of this thoughtful textbook: the author's concerted effort to avoid the deceitfully comfortable jargon of each field by translating key ideas and concepts into clear vernacular. *The Cognitive Neuroscience of Memory: An Introduction* is an ideal primer for students of the new science of memory, where exciting new interdisciplinary approaches are eroding the traditional boundaries between molecular, systems and psychological approaches.

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