BOOK REVIEW

Deciphering the Brain Mechanisms of Episodic Memory from a Computational Modeler's Point of View

How We Remember: Brain Mechanisms of Episodic Memory. Editor: Michael Hasselmo. MIT Press 2012, 383 pages. ISBN: 978-0-262-01635-3

In his "Principles of Psychology" William James defined memory as "the knowledge of an event or an item. . .with the additional consciousness that we have thought or experienced it before" (p. 610 in James, 1950). Almost 100 years later Tulving coined the term "episodic memory" to name the type of memory James was describing in his book. According to Tulving (1999) episodic memory is "the ability to transport oneself mentally back in time and to recollect an event or experience from personal past" as a slice of experience frozen in time. Thus recalling a memory is a recursive process where slices of the memory event recalled in a successive order can create the illusion of a continuous flow of past experience.

In his "How we remember: brain mechanisms of episodic memory" book Hasselmo argues against the notion of episodic memory as a discrete process, but redefines it as the "dynamics of episodic memory that allow us to relive a sequence of events as segments of a spatiotemporal trajectory with an explicit sense of position in continuous space and duration in continuous time." This includes an explicit sense of point of view and the direction and speed of actions. He then attempts to uncover the brain mechanisms of episodic memory by presenting a comprehensive theory of encoding and retrieval of episodic memories that bridges the gap between the cellular and behavioural levels. On the behavioural level Hasselmo focuses on the ability to encode and retrieve segments of spatiotemporal trajectories from personal experience. On the cellular level, he focuses on the dynamical properties of neurons in brain structures involved in episodic memory by presenting a model of how the cellular properties of these neurons could underlie the mechanisms of episodic memory.

The book includes a number of chapters that go in great length and depth on what is currently known about the deep questions in episodic memory: what roles do the entorhinal cortex, hippocampus, medial septum, and parahippocampal areas play? How does their anatomical, physiological, and pharmacological make-up allow them to play this role?

Hasselmo engages the reader by opening each chapter with a personal account, a story or an analogy that captures the essence of the topic to be described. In Chapter 1, he presents the behavioral data on episodic memory and provides an overview of his theory. In the next chapter, he provides an overview of the anatomy and physiology of the structures implicated in episodic memory. In Chapter 3, he provides an overview of the biological mechanisms of the entorhinal cortex and hippocampus in encoding space and time in episodic memories. In Chapter 4, he verbally presents his full model of episodic memory. He describes the model's details by appealing on the physical intuition of the reader and less on his/her analytical skills. The mathematical details of the model are described in a separate section later on in the book. In Chapter 5, he addresses the role of the hippocampus in forming associations between different individual items and events along a spatiotemporal trajectory. In Chapter 6, he describes the effects of drugs on the dynamics of encoding and retrieval of episodic memories. In Chapter 7, he presents an overview of models in memory-guided behaviour. Finally, in an appendix, he presents the mathematical tools required to quantitatively describe his episodic memory model detailed previously in the main text of the book.

Overall, Hasselmo does an excellent job in educating the reader about what episodic memory is and what are its brain mechanisms. He does so with clarity making his book a valuable resource of information to both readers naïve of the principles of neuroscience and more experienced brain researchers. Readers without a computational modeling background will find it accessible and intriguing. Practicing modelers will be inspired. What I felt was missing from the book was a final chapter with unanswered questions or future research avenues extending the Hasselmonian modelling approach to episodic memory. Nonetheless "How we remember: brain mechanisms of episodic memory" is an excellent book!

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