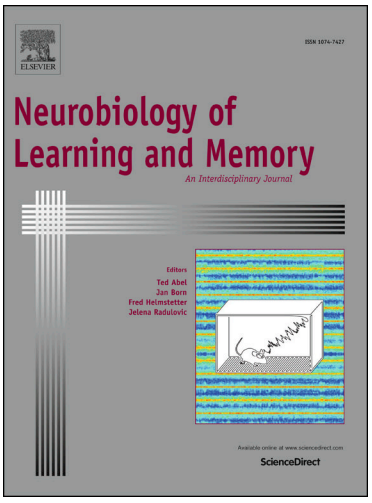

Hippocampal representations as a function of time, subregion, and brain state

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Hippocampal representations as a function of time, subregion, and brain state

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Running title: Windows of representational change

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Highlights
Hippocampal representations highlight shared or distinctive features of experiences
Preferred representations vary by subfield, neuronal excitability and neuromodulation
DG separates to support memory precision, while CA1 integrates for flexibility
Sustained neuronal excitability may link related experiences across time
Salience triggers release of neuromodulators, promoting separation or integration

Abstract

How does the hippocampus represent interrelated experiences in memory? We review prominent yet seemingly contradictory theoretical perspectives, which propose that the hippocampus distorts experiential representations to either emphasize their distinctiveness or highlight common elements. These fundamentally different kinds of memory representations may be instantiated in the brain via conjunctive separated codes and adaptively differentiated codes on the one hand, or integrated relational codes on the other. After reviewing empirical support for these different coding schemes within the hippocampus, we outline two organizing principles which may explain the conflicting findings in the literature. First focusing on *where* the memories are formed and stored, we argue that **distinct hippocampal regions** represent experiences at multiple levels of abstraction **and may transmit them to distinct cortical networks.** Then focusing on *when* memories are formed, we identify several factors that can open and maintain specialized time windows, during which the very same hippocampal network is biased towards one coding scheme over the others. Specifically, we discuss evidence for (1) excitability-mediated integration windows, maintained by persistently elevated CREB levels following encoding of a specific memory, (2) fleeting cholinergically-mediated windows favoring