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Accounting for change in declarative memory: A cognitive neuroscience perspective

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Abstract

The medial temporal lobe memory system matures relatively early and supports rudimentary declarative memory in young infants. There is considerable development, however, in the memory processes that underlie declarative memory performance during infancy. Here we consider age-related changes in encoding, retention, and retrieval in the context of current knowledge about the brain systems that may underlie these memory processes. While changes in infants' encoding may be attributed to rapid myelination during the first year of life, improvements in long-term retention and flexible retrieval are likely due to the prolonged development of the dentate gyrus. Future studies combining measures of brain and behavior are critical in improving our understanding of how brain development drives memory development during infancy and early childhood.

Keywords: Declarative memory; Infancy; Hippocampus; Memory development

In 1953, as part of a drastic treatment for severe and intractable epilepsy, patient H.M. underwent a temporal lobe resection, and subsequently became unable to store new information in memory (Scoville & Milner, 1957). Although memories from before his surgery remained largely intact, H.M. had no recollection of his everyday life since the surgery. He no long remembers people that he meets, he cannot learn the route to his new house, and he will read magazines over and over again without any sense of familiarity (Milner,

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Corkin, & Teuber, 1968). Hundreds of researchers have studied his impairment and demonstrated that despite his profound amnesia, H.M's ability to learn, under certain conditions, remains intact (Corkin, 2002). H.M. performs well on priming and conditioning tasks, and is able to acquire perceptual and cognitive-based skills at the same rate as controls.

To explain the specific pattern of impairment associated with hippocampal amnesia, Cohen and Squire (1980) suggested that there maybe a dissociation between remembering "that" and remembering "how". Although the idea that there may be more than one kind of memory was not new (Tulving, 1972), the fact that damage to a specific area of the brain caused a specific pattern of impairment led these researchers to suggest that different kinds of memory might be subserved by different brain systems. It is now generally accepted that structures in the medial temporal lobe (see Fig. 1), including the hippocampus and parahippocampal cortex, underlie the conscious recollection of facts and events (i.e., explicit or declarative memory). In contrast, parts of the striatum, cerebellum and brain stem are responsible for the implicit or procedural learning that is evident in priming, conditioning, and skill-learning tasks.

The idea that there may be multiple memory systems led to obvious questions among developmental psychologists studying memory: How do memory systems develop? How does the maturation of the brain regions that underlie these memory systems contribute to their development? Schacter and Moscovitch (1984) were the first to argue that the memory systems that are dissociated in amnesia are also dissociated during the course of typical development. According to their view, implicit memory, or the unconscious learning that is expressed by changes in task performance as the result of experience, is controlled by an early-developing system, which may be present at birth. In contrast, the development of explicit memory is quite protracted, emerging when a late-developing

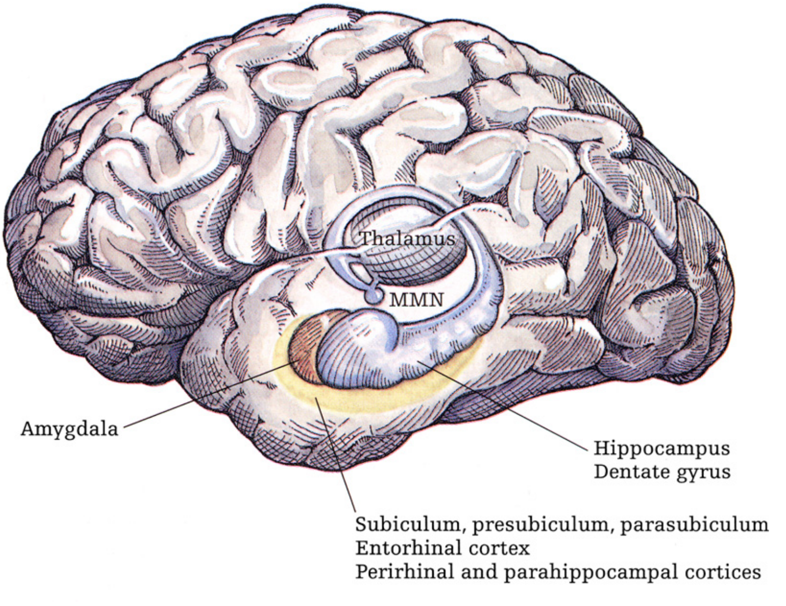

Fig. 1. The medial temporal lobe memory system. Source: From Bloom, F., Nelson, C. A., & Lazerson, A. (2001). *Brain, Mind, and Behavior* (3rd ed.). New York: Worth Publishers.