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Competition among multiple memory systems: converging evidence from animal and human brain studies

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Abstract

Research of the neurobiological bases of learning and memory suggest that these processes are not unitary in nature, but rather that relatively independent neural systems appear to mediate different types of memory. Neurobiological studies, for instance, have identified separable cognitive or “declarative” and stimulus “response habit” memory systems that rely upon the medial temporal lobe (e.g. hippocampus) and basal ganglia (e.g. caudate “putamen), respectively. Evidence indicates that multiple memory systems are activated simultaneously and in parallel in various learning tasks, and recent findings suggest that these systems may interact. One form of interaction between medial temporal lobe and basal ganglia memory systems appears competitive in nature, and has been revealed in non-human animal studies in which damage to a given memory system results in enhanced learning. Recent human

neuroimaging research has also provided evidence in favor of competition between memory systems. Thus, converging evidence across species supports the hypothesis of interactive multiple memory systems in the mammalian brain. Potential neurobiological mechanisms mediating such interactions include direct anatomical projections between the medial temporal lobe and basal ganglia, indirect neuromodulatory influences of other brain structures (e.g. basolateral amygdala) and activity of neocortical brain regions involved in top-down response selection.



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Keywords

Multiple memory systems; Brain studies; Animals and humans; Hippocampus; Basal ganglia; Striatum; Medial temporal lobe

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