Internally generated assembly sequences in the hippocampus and episodic memory

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Our ability to recall a spatio-temporal sequence of events from our personal past experience is called episodic memory. It is believed that ‘mental travel in time’ is uniquely human. Clinical evidence shows that the hippocampus is critical to coding and retrieving of one’s past episodes. The hypothetical neuronal source of an episode recall is a network wherein the neuronal assemblies representing different events within the same spatial and temporal framework subsequently activate each other. Interestingly, experiments with rodents have revealed that cell assemblies in the hippocampus respond differentially to spatial cues and thus subsequently visited places are represented by the temporal relationship among the neurons. However, it is believed that spatial cues continuously control the hippocampal activity. Given the assumption that neuronal algorithms serving a useful function in a simple brain can be used for more complex functions in larger brains, one can hypothesize that a rodent’s hippocampal network is capable of the perpetuation of cell assemblies even without any external control. I have demonstrated that hippocampal cell assemblies evolve internally when environmental cues are fixed while a rat is running in a wheel (is ‘frozen’ in space) and that the specificity of the activated assemblies carries information about a subsequent choice of an animal in a memory task. I have also demonstrated that hippocampal assemblies are activated in a steady, non-progressing manner during a wheel running with minimal memory demand. These results indicate that the internal dynamics of a rodent’s hippocampal network is capable of generating context-dependent, sequentially progressing neuronal assemblies.

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