How spaced learning affects stability of hippocampal neural correlates of memory

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In this work we assessed how the turnover of hippocampal CA1 neurons activity over days is modulated by two different spaced learning regimes.

Hippocampal CA1 neurons are of critical importance in learning and memory. As such, extensive research has been directed to elucidate the cellular mechanisms of synaptic memory consolidation, characterizing plasticity and stability of neural response as correlates of memory. Recently, by using miniaturized calcium-imaging neuronal recording systems, scientists have gained the ability to both: i) record a large number of cells with individual resolution and ii) to track these ensembles across several days, in order to understand the mechanisms of what is called system's memory consolidation. With these novel tools, (Ziv *et al.*, 2013) have demonstrated that the neuronal ensemble that participates during the activation elicited by a known event is not constant or rigid over time, but instead there is replacement rate of activation over days, called turnover. They have hypothesized that this turnover could be related to either an intrinsic physiological turnover of cell process like synaptic spines turnover, or to neural population activity dynamics dictated by cognitive processes related to memory formation and recall. We repeated this experiment changing the frequency of exposition to the same spatial task and measured how space learning influences the turnover rate of hippocampal CA1 neurons activity over days. We found indeed that the rate of turnover changes with the frequency of training. Our results shed light into how memory is encoded and recalled over long-term time scales (days to weeks) and how this information is modulated by the frequency of learning.

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