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Mapping the Arrangement of Neural Ensembles Involved in Distinct Stages of Spatial Memory Processing in Hippocampal Regions

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Abstract

Memory traces are believed to be supported by neural ensembles sculpted by learning activity. Reactivation of these ensembles would elicit memory recall. Although the recruitment of neural ensembles appears to be essential to memory formation and storage, not much is known of the exact arrangement of such ensembles during memory processes.

The goal of this project is to identify ensembles of neurons associated with distinct stages of the processing of a spatial memory in the hippocampus of mice. We hypothesize that as memory progresses, from early to late (more consolidated) stages, the majority of neurons constituting the ensemble will migrate from the entry to the termination areas of the hippocampal network. Using Immediate Early Gene fluorescent tagging methodology, we examined how the process of acquisition, consolidation, and extinction of memory shape neural ensembles in the hippocampus of the mouse. We trained transgenic mice expressing the Arc-Cre/eYFP double transgene in an active place avoidance task and activated fluorescent (eYFP) tagging at the specific memory stages, by injecting Tamoxifen.

Our hypothesis predicts that each stage of memory would require different amounts of neurons across the hippocampus network. We anticipate that memory acquisition (learning) recruitment of neurons will be higher at the dentate gyrus (DG), the entry point to the hippocampus, and lower at the CA1 area, its exit point. Furthermore, as memory gets consolidated, we expect to see a decrease in the DG and an increase in CA1. With this work, we hope to provide insight into how memory traces are represented in the brain.

KEYWORDS: Dentate gyrus; CA1; Spatial memory; Active place avoidance; Neural ensembles

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ABSTRACT

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