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

Mikayla Hutchinson*       Juan Marcos Alarcón, PhD†
Adriana Melchiades, PhD‡

*†‡SUNY Downstate Medical Center
†‡SUNY Downstate Medical Center

Copyright ©2018 by the authors. Journal of Health Disparities Research and Practice is produced by The Berkeley Electronic Press (bepress). https://digitalscholarship.unlv.edu/jhdrp
Mapping the Arrangement of Neural Ensembles Involved in Distinct Stages of Spatial Memory Processing in Hippocampal Regions*

Mikayla Hutchinson; Juan Marcos Alarcón, PhD; and Adriana Melchiades, PhD

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

*The STEP-UP HS program is supported by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health, Grant #: 2R25DK078382-12.
Mapping the Arrangement of Neural Ensembles Involved in Distinct Stages of Spatial Memory Processing in Hippocampal Regions

Mikayla Hutchinson
Juan Marcos Alarcón, PhD, SUNY Downstate Medical Center
Adriana Melchiades, PhD, SUNY Downstate Medical Center

Coordinating Center: Stanford University

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

ACKNOWLEDGEMENTS
Mapping the Arrangement of Neural Ensembles Involved in Distinct Stages of Spatial Memory Processing in Hippocampal Regions
Hutchinson, Alarcón, and Melchiades

The STEP-UP HS program is supported by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health, Grant #: 2R25DK078382-12.