



Mathematical, Computational and Systems Biology Graduate Programs

Ph.D. DISSERTATION DEFENSE

Friday, November 21, 2025

1:00 PM

ISEB 1200

Zoom link: <https://uci.zoom.us/j/94989419837>

Erica Ward

Advisor: Liz Chrastil (NBB)

Human Brain Network Dynamics and Behaviors of Navigational Learning and Memory

Navigation is a daily process, ubiquitous to humans and creatures alike. Although navigating may seem simple, especially when commuting between well-known locations like home and work, learning new environments depends on the synergy of many cognitive processes, such as attention, memory, and decision-making. Due to this complexity, it is not surprising that navigational abilities vary highly across individuals. While several studies have focused on human exploration behaviors and brain activity in already-known environments, comparatively little is known about the acquisition of this knowledge and the source of variation across individuals' navigational skills. This dissertation investigates human navigational learning and memory using a dataset of 113 healthy young adults who completed a challenging virtual maze task during fMRI scanning. Participants had 16 minutes to explore a virtual hedge maze and learn the locations of nine objects. Memory for object locations was then tested across 48 time-limited trials, in which participants navigated from one object to another. Accuracy ranged from near 0% to 100%, providing a rich source of variation for examining the behavioral and neural correlates of navigation. Behavioral analyses combined traditional, novel, and survey-based metrics to characterize exploration strategies and their relationships to navigational performance across individuals. Neural analyses used functional connectivity and dynamic community detection to investigate the brain networks involved in learning and memory, as well as network dynamics such as disjointedness, and their associations with individual differences in behavior and performance. Together, these behavioral and neural findings provide comprehensive insight into the cognitive and brain mechanisms that support navigation in novel environments and help explain why some people are more effective navigators than others.