IPH Lecture Series

Active navigation and the human brain

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Reception will follow the talk

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Location: Senate Chambers, Ross N940

Abstract

Navigation is a complex and dynamic task that engages multiple brain systems for perception, cognition, planning and decision making, and motor control. Most studies focusing on the brain systems mediating navigation use sparse environments, simple tasks, and reduced models. Such studies optimize experimental control, but because the brain is a highly nonlinear dynamical system they are unlikely to lead to models that accurately explain brain function during natural navigation. In this talk I will describe human functional neuroimaging experiments that overcome many of the limitations of prior navigation studies, and which produce rich computational models that explain human brain function during naturalistic, active navigation. In these experiments participants first learned to navigate through a large virtual city containing hundreds of distinct roads, buildings and landmarks. After learning to criterion participants performed a taxi driver task in the MRI scanner while brain activity was recorded. Banded ridge regression was then used to create high-dimensional voxelwise encoding models separately for every subject, and model prediction accuracy and generalization was tested using a separate data set. The encoding model framework allowed us to simultaneously evaluate 33 separate hypotheses about navigation-related representations that might be represented in the human brain. In this talk I will summarize the results of these experiments, focusing on three different aspects of these rich data: visualization and interpretation of the fit voxelwise encoding models across the cortical surface and in the hippocampus; evaluation of navigation-related networks; and decoding of information from navigation-related functional regions. Although I will be focusing on navigation in this talk, the methods that underpin these studies can be applied to many different problem domains and across species, and my laboratory has developed a large suite of open source tools and tutorials to facilitate adoption of this approach. Therefore, I hope that this talk will be of interest to a broad audience.

Biography

Jack Gallant is Chancellor's Professor at the University of California at Berkeley. He holds appointments in the Departments of Psychology, Neuroscience, and Electrical Engineering and Computer Science. He is a senior member of the IEEE, and the 2022 Chair of the IEEE Brain Community. Professor Gallant's research focuses on high-resolution functional mapping and quantitative computational modeling of human brain networks. His lab has created the most detailed current functional maps of human brain networks mediating vision, language comprehension and navigation, and they have used these maps to decode and reconstruct perceptual experiences directly from brain activity. Further information about ongoing work in the Gallant lab, links to talks and papers and links to online interactive brain viewers can be found at the (somewhat out-of-date) lab web page: http://gallantlab.org.