From Cognitive Maps to Cognitive Graphs

TIME:
2:00-3:00 PM, Friday, November 9, 2018

VENUE:
Room 385, Geography Building, Zhongbei Campus, East China Normal University

SPEAKER:
William H. Warren, Brown University

ABSTRACT:
The consensus picture of spatial navigation in humans and other mammals is that, as we explore the environment, we record displacements and orientations with the path integration system, learn the locations of places, and build up a metric Euclidean cognitive map, which is necessary for taking novel shortcuts. This picture is underwritten by the head-direction, grid, and place cell systems.

I will develop a somewhat different picture, based on behavioral experiments in ambulatory VR. In practice, human path integration is unsuited for building a geometrically consistent map, but it is well suited for making local, piecewise measurements of path lengths and turn angles. Navigators thus learn a network of paths between places, augmented by rough local metric information, akin to a labeled graph. However, this local information is not integrated into a geometrically consistent map. Consequently, novel shortcuts are highly unreliable and navigators are insensitive to large violations of Euclidean structure.

I will suggest that spatial knowledge is better characterized as such a cognitive graph. Knowledge of path lengths and junction angles may be noisy, biased by experience, and geometrically inconsistent. Yet apparently Euclidean behavior can be explained by the labeled graph hypothesis. Novel detours can be found by finding shorter routes through the graph; approximate shortcuts can be generated by vector addition through the graph; and individual differences in navigation ability may reflect the resolution of local metric information.

BIOGRAPHY:
William H. Warren is Chancellor’s Professor of Cognitive, Linguistic, and Psychological Science at Brown University and Director of the Virtual Environment Navigation Lab (VENLab). He received his undergraduate degree from Hampshire College (1976), his Ph.D. in Experimental Psychology from the University of Connecticut (1982), did post-doctoral work at the University of Edinburgh (1983), and has been at Brown ever since. He uses virtual reality techniques to investigate the visual control of human action, including optic flow, locomotion, collective crowd behavior, spatial navigation, and the dynamics of perceptual-motor coordination. Warren is the recipient of a Fulbright Research Fellowship, an NIH Research Career Development Award, and Brown’s Teaching Award for Excellence in the Life Sciences, and serves as President of the International Society for Ecological Psychology.