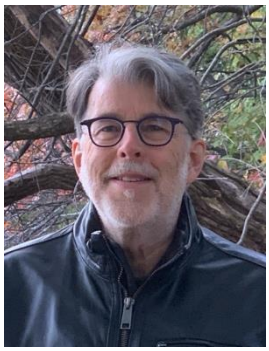

William H. Warren

Chancellor's Professor

Department of Cognitive, Linguistic, and Psychological Sciences

Brown University

Providence, RI, USA

Presentation title:

The Perception-Action Coupling in Collective Dynamics

Abstract:

In the late 20th c. people began to claim that vision and motor control, which had long been studied in isolation, were mutually constraining and should be studied together, launching the field of perception and action. James Gibson and his students argued that the biological function of vision was not to perceive points floating in empty space, but to guide action in an ecological environment. This complemented the view of Nikolai Bernstein and his students that that the function of the motor system was not to control a marionette dangling in empty space, but to perform goal-directed actions in a physical environment. Perception and action were thus entangled in adaptive behavior, constrained by information about a shared environment. In 1990, I published a paper called The perception-action coupling that tried to situate perception and

action in the context of the self-organizing dynamics of the organism-environment system. The basic idea was that interactions with the environment both generate and are guided by perceptual information, and that task-specific action modes (low-dimensional manifolds) emerge from the dynamics of this interaction. In this talk, I will briefly look at how this basic picutre has been elaborated with visual-motor mappings (1998), behavioral dynamics (2006), inward to neural dynamics (others), and outward to collective dynamics (2018). We are currently investigating how local interactions between pedestrians generate global patterns of collective crowd motion, or human 'flocking' – a many-body version of the degrees-of-freedom problem. The solution lies in the perception-action coupling. Based on experiments on participans walking in a virtual crowd, we find that each individual follows their neighbors by canceling their neighbor's optical expansion and angular velocity (Dachner, Wirth, Richmond, & Warren, 2022). The mechanism of self-organization is distance-weighted averaging of neighbors (Cucker & Smale, 2007; Wirth & Warren, 2021), and these optical motions decay naturally with distance due to the laws of optics and occlusion. Thus, a simple perceptuion-action coupling gives rise to emergent collective behavior.

Short CV:

William H. Warren is Chancellor's Professor of Cognitive, Linguistic, and Psychological Sciences at Brown University and Director of the Virtual Environment Navigation Lab (VENLab). He received his undergraduate degree in Psychology, Biology, and Philosophy 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, where he served as Department Chair (2002-10). He uses virtual reality techniques to investigate the visual control of human action, including topics such as optic flow, locomotor control, spatial navigation, collective crowd behavior, and the dynamics of perceptual-motor coordination. Warren is the author of 134 research articles and chapters, and the recipient of a

Fulbright Research Fellowship, an NIH Research Career Development Award, and Brown's Teaching Award for Excellence in the Life Sciences. He has been Professeur Invité at the University of Paris Orsay, University of Aix-Marseille, and a Visiting/Distinguished Lecturer at Oxford, HKU, University of Alberta, NYU-ECNU Shanghai, and TU Berlin. He is an elected Fellow of the Society of Experimental Psychologists, and is currently President of the International Society for Ecological Psychology.