University of Zurich[UZH]

Department of Economics – Neuroeconomics Seminar

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Structuring experience in cognitive spaces

A fundamental question in cognitive neuroscience is how the brain organises experience in a format that supports flexible thought and adaptive behaviour. Systems neuroscience research on place and grid cells has shown that the hippocampal–entorhinal system provides an internal map of physical space. Our work builds on the idea that this navigational machinery also offers a more general coding principle for cognition: the brain structures experience in low-dimensional relational spaces, or “cognitive maps”, that capture the geometry of spatial layouts, task states, actions, concepts, values, and memories. In this talk, I will present recent evidence from fMRI, MEG, behavioural experiments and computational modelling suggesting that the hippocampal–entorhinal system does not encode a single fixed map, but dynamically constructs, selects, and transforms multiple overlapping relational representations. Recent studies from our lab show that hippocampal representations track similarities between states, actions, and outcomes, while entorhinal grid-like codes generalise beyond physical space to abstract action and value spaces, supporting prospective evaluation, conceptual inference, and decision making. Our overarching goal is to develop a mechanistic, multi-level account of cognition that links computation, biology, psychology, and clinical translation. Using memory and cognitive mapping as model systems, we aim to understand how multiple maps are coordinated in real time as goals, contexts, and uncertainty change; how the brain arbitrates between overlapping representations to balance generalisation and interference; and how these mechanisms break down in clinical dysfunction. By aligning representational geometry, neural circuit architecture, behaviour, and clinical research, we seek to advance an integrated theory of cognitive function that captures both its remarkable flexibility and its vulnerability.