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Neurocomputational Tools for Probing Subjective Experience

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Abstract

Understanding how the brain monitors and interprets its own states is central to theories of metacognition and consciousness. My lab develops novel analytic, behavioral, and computational approaches to characterize *higher-order representations* – the neural representations that reflect not just the state of the environment, but also our evaluations of those representations – and the way these representations manifest in our behavior and learning. In this talk I will highlight several ongoing and interacting lines of research that drive at this goal, with focus on combining noninvasive functional neuroimaging (fMRI), generative artificial intelligence and state of the art machine learning techniques, probabilistic computational models, and novel analytic approaches to quantitatively characterizing relevant behaviors in humans. Techniques we are developing and using include *introspective psychophysics*, denoising diffusion models trained with reinforcement learning algorithms, and domain adaptation approaches to characterizing transformations among related neural representations. Finally, I will also describe how these tools may provide new ways to empirically arbitrate between competing theories of how conscious subjective experience arises from brain activity.

Short biography

I am an Associate Professor in the UCI Department of Cognitive Sciences with affiliation in the UCI Department of Logic & Philosophy of Science, a Fellow in the Canadian Institute for Advanced Research Brain Mind & Consciousness program, and President, Co-founder, and Chairperson of the Board of Directors at Neuromatch – a nonprofit serving 40,000+ participants worldwide with educational and field-building initiatives across computational neuroscience, deep learning, computational climate science, and neuroAI.

My research aims to reveal how the brain represents and uses uncertainty, including metacognitive evaluation and introspection, and these capacities' relationship to conscious subjective experience. I use psychophysics, neuroimaging (fMRI, mostly) in humans, computational modeling, and machine learning and artificial intelligence to study these topics. I am also passionate about developing new approaches to collaborative scientific research and education that break down geopolitical and financial barriers to success.

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