Probing human memory and decision making at the single-neuron level

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The decisions we make, the memories we form, and the skills we learn define each of us as individual beings. While much has been learned about how circuits of neurons implement simple individual tasks, little is known about how such circuits give rise to human cognition. What defines when an episodic memory begins and ends? How do we bring back to mind the face of a person from memory? Why is maintaining memories in working memory effortful? We are probing these questions by recording from individual neurons in human subjects undergoing neurosurgical procedures, with a focus on the hippocampus, amygdala, and medial frontal cortex. I will discuss the neural substrate of working memory, evidence for generative processes that allow us to re-live past experiences through imagination, and how disentangled abstract representations enable rapid learning and cognitive flexibility. I will also discuss new information geometric tools to quantifying the structure of population codes that have enabled these discoveries. Our findings reveal single-cell correlates of key aspects of human cognition and suggest specific interventions for new treatments for memory disorders.

Biography

The laboratory of Ueli Rutishauser, PhD studies the neural mechanisms of memory and decision making using computational and experiment methods. A major focus of his work is to advance the technique of human single-neuron recordings and its use to deciphering a cellular-level understanding of human cognition and its impairment by disease. Dr. Rutishauser's training includes a BS in computer science, a PhD in Computation & Neural Systems from Caltech and postdoctoral fellowships at Caltech and the Max Planck Institute for Brain Research. He is currently Board of Governors Professor in Neurosciences and Director of the Center of Neural Science and Medicine at Cedars-Sinai Medical Center and Faculty Associate in Biology and Biological Engineering at the California Institute of Technology.