Abstract

Decision-making, a fundamental cognitive process, provides valuable insights into how internal states and representations shape behavior. In this talk, I will explore the interplay between motivational states, sensorimotor learning, and cross-modal generalization, based on experiments with mice designed to reveal the neural circuits driving decision-making. In the first part, I will discuss how thirst-related motivation modulates decision-making and learning in a whisker-based sensory task. Our findings show that performance changes during training were driven primarily by shifts in motivational control, rather than associative learning. Neurons in the secondary somatosensory and premotor cortices dynamically adapted their response patterns according to the mice's motivational state in accordance with task performance. These results, supported by computational models of decision-making, shed light on the cognitive mechanisms that underlie sensorimotor learning under varying motivational states. In the second part, I will discuss how mice use internal representations of peri-personal space to rapidly generalize sensorimotor associations across vision and touch. Using multiscale calcium imaging and anatomical tracing, we identified key visuo-tactile associative regions in the dorsal cortex, characterized by aligned spatial maps and supramodal coding at the single-neuron level. Targeted neuronal silencing and optogenetic sensory substitution allowed us to pinpoint a specific cortical area crucial for cross-modal generalization.These insights not only deepen our understanding of the neural basis of decision-making but also reveal fundamental principles of how the brain integrates and generalizes information across different sensory modalities.

A short biography

Sami El-Boustani is an Assistant Professor in the Department of Basic Neurosciences at the University of Geneva. After earning a Master degree in theoretical physics from EPFL (Switzerland), he pursued a second Master's in Cognitive Science from l'Ecole Normal Supérieure in Paris (France). He then completed his Ph.D. in neuroscience at Sorbonne University, focusing on sensory processing and plasticity in cortical networks. Following his Ph.D., Sami conducted postdoctoral research at MIT (USA), studying interneurons and dendritic plasticity, and later at EPFL, exploring brain circuits in the mouse whisker system. In 2019, he opened his lab at University of Geneva after being awarded a SNSF Eccellenza fellowship.