University of Zurich[UZH]

Department of Economics – Neuroeconomics Seminar

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Endogenous Neuromodulation of Cortical Decision Computations

Variability is a hallmark of human choice behavior: decision-makers often arrive at different choices when faced with the same alternatives. Most computational models of decision-making account for this behavioral variability by explicitly introducing “noise” into the decision process. Other models postulate that choice variability reflects hidden, but systematic, biases in the decision process. I will present converging evidence from a number of experiments that helps reconcile these ideas. We monitor subjects’ behavior together with arousal state (assessed through pupil diameter) and neural population activity (assessed through fMRI and MEG) during elementary sensory-motor choice tasks. This reveals that a substantial component of choice variability is explained by trial-to-trial fluctuations in phasic arousal signals during decision formation. These arousal signals account for systematic variations in subjects’ decision biases. Brainstem fMRI shows that phasic arousal signals reflect responses of a network of brainstem systems controlling cortical state, including the noradrenergic and dopaminergic systems. Further, the effect of phasic arousal on bias is mediated by a remarkably specific modulation of choice-encoding pattern signals in frontal and parietal association, but not in sensory cortex, cortex. Our results suggest that the phasic release of neuromodulators during decision formation suppresses choice biases through a selective editing of cortical decision signals. Phasic neuromodulation is an integral part of the decision process: without monitoring it, the resulting variations in bias appear as random noise.