Flexible categorization in Perceptual Decision Making

G.Prat-Ortega[1,2], K. Wimmer[2], N. Wilming[3], T.H. Donner[3], A. Roxin[2], J. de la Rocha[1]
1. Cortical circuits dynamics, Institut d'Investigacions Biomèdiques August Pi i Sunyer, Barcelona
2. Computational Neuroscience, Centre de Recerca Matemàtica, Barcelona
3. Department of Neurophysiology and Pathophysiology, University Medical Center Hamburg-Eppendorf, Hamburg

Our brains interpret ambiguous streams of information to make decisions and guide our behavior. The canonical approaches to model this cognitive function are based on diffusion processes that assume bounded or unbounded perfect integration of the stimulus. Here we study the decision process in neurobiological models that can explain single neuron activity recorded while animals are performing a perceptual decision making task. In these models the evidence supporting the two possible choice are encoded by the activity of two populations of excitatory neurons. Once the stimulus is presented, the network integrates it until a decision is reached (an stable state of the system). In such models we found that increasing the magnitude of the stimulus fluctuations led to a new integration regime not present in canonical diffusion models, which we call flexible categorization. In this regime, fluctuations late in the trial robustly generate decision reversals (transitions between stable states) by overcoming the internal dynamics when the initial choice is incorrect. One signature of flexible categorization is a non-monotonic dependence of the accuracy and the response consistency on the stimulus fluctuations. Another is a transition in the temporal weighting of the stimulus impact on the upcoming choice from primacy to recency as a function of the trial duration. We found evidence for such a transition in data from a series of psychophysical experiments.