Distinct Sources of Deterministic and Stochastic Components of Action Timing Decisions in Rodent Frontal Cortex

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Abstract:

The selection and timing of actions are subject to determinate influences such as sensory cues and internal state as well as to effectively stochastic variability. Although stochastic choice mechanisms are assumed by many theoretical models, their origin and mechanisms remain poorly understood. Here we investigated this issue by studying how neural circuits in the frontal cortex determine action timing in rats performing a waiting task. Electrophysiological recordings from two regions necessary for this behavior, medial prefrontal cortex (mPFC) and secondary motor cortex (M2), revealed an unexpected functional dissociation. Both areas encoded deterministic biases in action timing, but only M2 neurons reflected stochastic trial-by-trial fluctuations. This differential coding was reflected in distinct timescales of neural dynamics in the two frontal cortical areas. These results suggest a two-stage model in which stochastic components of action timing decisions are injected by circuits downstream of those carrying deterministic bias signals.

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