Multisensory Integration and Decision Making

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Abstract:

Perceptual decisions in real world are often based on multiple sensory inputs whose reliabilities rapidly vary over time, yet little is known about how our brain integrates these inputs to optimize behavioral output. Here we show sensory evidence with ever-changing reliability can be accumulated near optimally, in a Bayesian sense, by simply taking time-invariant linear combination of neural activity across time and modalities, as long as the sensory inputs are encoded close to an invariant linear probabilistic population code (iIPPC). Recordings in the lateral intraparietal area (LIP) while macaques performed a vestibular-visual optimal integration heading discrimination task in which both stimuli followed a Gaussian-shape velocity profile revealed that neurons accumulate vestibular acceleration and visual velocity evidence. Importantly, at the population level, LIP activity ramps up across time and modalities in a way consistent with the iIPPC theory, providing a remarkably simple and biologically plausible solution to optimal multisensory decision making.