Modifying the magnitude of stimulus noise can distinguish between neural mechanisms of evidence integration

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Our brains interpret ambiguous streams of information to take 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 integration process in neurobiological models with winner take all dynamics that can be reduced to a diffusion process. To show the key mechanisms that differentiate this model from the canonical ones, we characterized the integration process by quantifying the shape and magnitude of the Psychophysical Kernel. With this approach, we found that increasing the magnitude of the fluctuations of the stimulus, a new integration regime emerged, named flexible categorization, in which the attractor dynamics of the system were balanced by the stimulus fluctuation. The existence of this regime, specific of the neurobiological models, gave rise to a non-monotonic dependence of the accuracy and the response consistency on the stimulus fluctuations. The existence of a flexible categorization regime, a signature of winner take all dynamics, could therefore be demonstrated by testing these novel predictions in a psychophysical experiment.

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