Building Models of the World: Neural Mechanisms of Bayesian Model Averaging

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Presentation Abstract Summary Building adequate representations of the environment is central for adaptive behavior, but little is known about the neural computations of forming such internal models. In a functional magnetic resonance imaging study, we investigated the neural mechanisms of (Bayesian) model comparison, which is a crucial aspect of forming structural representations. Subjects performed a gambling task where successful behavior depended on forming beliefs about the current context, posing a hierarchical inference problem on task structure and choice behavior. We found evidence for Bayesian model averaging in behavior, suggesting that subjects' choices were best explained as the uncertainty-weighted average over all possible models (contexts), as opposed to model selection or parameter learning. Neurally, belief updates about models were encoded in the anterior cingulate cortex and ventral midbrain, and model uncertainty – a key feature of model averaging - was encoded in dorsolateral prefrontal cortex, whereas beliefs about current states and their value were encoded in the ventromedial prefrontal and orbitofrontal cortex. Our results suggest a functional gradient along prefrontal cortex for operations on the model- and state-space, and provide insight into the neurocomputational basis of developing accurate and generalizable mental representations, which are likely to be central for understanding pathological behavior in psychiatry.

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