**Abstract**

When faced with complicated decisions, humans use models of varying complexity to integrate information to guide behavior. We describe a general method for using the tools of information theory to quantify model complexity and optimality without needing knowledge of the underlying decision algorithm. In simulated tasks, complex mental models provided more accuracy, but performed less optimal compressions of task information than simpler models, highlighting a tradeoff between cognitive effort and accuracy. This trend was corroborated using human data, where measured model complexity was significantly correlated with decreasing optimality in the Information Bottleneck (IB) space. Finally, we explore the potential for applying these methods to analyze population differences in task performance between Major Depressive Disorder (MDD) patients and healthy controls. The IB method, which highlights the multiplicity of optimal models for a given task, may be a useful tool in studying variability in decision making models across many clinical paradigms.