

Neural mechanisms and representations for cognitive flexibility

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Abstract

Humans are very flexible in behavior. Without going through any trial-and-error learning process, we can immediately follow instruction to carry out a novel task. What are the neural mechanisms and representations that support such cognitive flexibility? In this talk, I will discuss how various prefrontal and hippocampal areas coordinate to carry out instructions, which can take the form of concrete or abstract rules. For concrete stimulus-response (S-R) rules such as “stop when you see red traffic lights”, I will use a neural network model to address why novel behavioral mappings can be learned so rapidly and how such novel mappings, when incongruent with habits, suppress proponent responses. For abstract S-R rules such as “call policies when you see violence”, the stimulus part, namely “violence”, can be bound to specific encounters, such as raping, bullying, or street fights. I will present preliminary results from multivariate pattern analyses of fMRI data that reveal where such flexible variable-binding occurs in the brain. The anterior prefrontal cortex is shown to play a key role in the instantiation of abstract S-R rules.