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Categorical decision-making in a fronto-striatal circuit

Categorical decision-making can provide a flexible linkage between sensory stimuli and behavioral responses. We trained rhesus macaques and human observers to perform a speed categorization task. The stimulus consisted of randomly generated, coherently moving dots. The speed of the motion was randomized on each trial. Subjects indicated whether they perceived motion as "fast" or "slow" by making a saccade to one of two targets. The position of the targets was randomized from trial to trial to dissociate the categorical "fast/

slow" decision from the motor response. Correct trials were reinforced with a juice reward. Human subjects performed the identical task, also using saccadic responses and receiving juice rewards. Event-related fMRI was performed to identify task related neural activity. Subjects showed significant activation related to the difficulty of the decision in a fronto-striatal circuit comprising the anterior insula, medial frontal gyrus, ventral striatum, and dorsomedial thalamus.

The same task was used for neuronal recording in monkey Frontal Eye Field, which provides cortical input to the striatum. The frontal eye field (FEF) is a region of prefrontal cortex that is involved in linking visual stimuli to motor responses. FEF is thought to be involved in selecting visual targets for eye movements. However, it is not known whether FEF is capable of playing a role in categorizing visual stimuli independently of a specific motor response. Activity during the decision period was significantly modulated by stimulus speed in roughly one-third of the neurons. Neural activity changed significantly when the category changed in one-third of the cells. Neurons that preferred faster speeds tended to be more active on trials with a "slow" criterion, and vice-versa. Neuronal activity could be used to predict the animals' category choices. These results demonstrate that FEF activity is influenced by stimulus category and suggest a possible model for categorical decision-making.

Vince Fererra
Columbia Medical School