

Prefrontal control of impulsive action

Results:

Impulse control - withholding short term benefits to achieve longer term goals - is an important facet of goal-directed behavior. Frontal cortex has been hypothesized to exert top-down control of impulsive actions. We investigated neural correlates of impulse control in frontal cortical areas.

In an impulse control task, rats interacted with a waiting port and a reward port. While waiting in the waiting port, size of the reward available at the reward port switched from small to big following a signaled but unpredictable interval. The waiting time of the rats varied randomly across trials. Through multiple single neuron recordings from the frontal cortical areas, we found a neural activity which predicts the waiting time of the rat. There were 20% of predictive neurons in premotor area of frontal cortex, but close to chance level (7%) in the medial prefrontal cortex. A different analysis revealed that a subpopulation of neurons in the premotor area showed ramping activity during the waiting, which reached the same firing rate just before the leaving. The rate of ramping activity was negatively correlated with the waiting time in a majority of ramping neurons. When we tested the neural activity in 2 different impulse control tasks requiring different actions, it is suggested that the waiting time predictive activity in the premotor area does not represent action-non-specific signal such as an impulse control signal, but represents action-specific signal, such as the timing of a particular action. These results suggest an involvement of premotor cortex neurons in deciding the timing of action in the context of impulse control task.

Area(s) of interest:

systems neuroscience

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