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Presentation Abstract

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Presentation Title: Neural correlates of action choice and RT in dorsal premotor cortex

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Abstract: How does the primate brain make decisions based on sensory input and decide which action to perform when? Lesion studies suggest that dorsal premotor cortex (PMd) is involved in mapping sensory cues to actions. One action selection framework proposed for ambiguous circumstances is that PMd simultaneously encodes potential reach directions (Cisek & Kalaska, 2005). As information allowing for reach selection appears, populations of neurons selective for a reach direction compete and eventually one population wins, enhancing its firing rate over the other population and resulting in a reach. This makes three predictions. First, in ambiguous reach contexts, neurons in PMd selective for different reaches should initially respond regardless of eventual choice. Second, over time one selective population should enhance its firing rate, winning the competition and resulting in a reach. Third, the arm movement reaction time (RT) should closely follow the time course of neural competition. We tested these predictions in PMd of a monkey performing a visual choice RT task.
A trained monkey used his right arm to report the dominant color in a central static checkerboard composed of isoluminant red and green squares. The percentage of red and green in the stimulus varied from trial to trial. The monkey's behavior followed behavior typical of visual RT tasks; increases in difficulty led to more discrimination errors and slower RTs. Most RTs varied between ~400 ms for the

easiest discrimination to ~550 ms for the hardest discriminations (range: 300 to 1000 ms). While the monkey performed this task, we recorded the activity of single neurons (70) and multi-units (19) from the arm region of left PMd.
We observed a mixed population of neural responses in PMd. Broadly, one subset of the population was movement sensitive (53/89), changing its firing rates just before (~200 ms) the reach onset. However, other neurons (36/89), resembling "visuomovement" cells responded rapidly after checkerboard onset regardless of the eventual choice. All three predictions were supported by data from visuomovement cells. Immediately after stimulus onset, cells selective for rightward and leftward reaches exhibited comparable firing rates. Over time, however, the absolute difference in activity of these two populations increased; achieving on average a 25 spikes/s difference (~100 ms) prior to movement onset. Importantly, the evolution of this activity difference was faster for fast RTs and slower for slower RTs. These results extend the competition hypothesis and suggest that dynamics in PMd neurons may mediate the selection of the action to perform and when to perform it.

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DECISION MAKING

MOTOR CORTEX

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