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Presentation Abstract

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Title:	Neurons in monkey premotor cortex change roles across complex movements
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Abstract:	Neurons in dorsal premotor cortex (PMd) show modulation of their activity both during movement and during a plan period, after an instructive cue but before a go cue. Two assumptions have guided prior thinking about the relationship between plan and peri-movement activity in PMd: (1) neurons can be tuned primarily for the plan period, primarily for the peri-movement period, or can be modulated in both periods (Riehle & Requin 1989); and (2) neurons modulated during both the plan and movement periods have similar preferred movements for both (e.g., Cisek 2006). We trained a rhesus monkey to perform a novel variant of the delayed-reach paradigm, called the maze task (Churchland et al, this volume), which involved a wider variety of reaches than most prior tasks. The monkey controlled a virtual cursor floating above his hand, and was required to make delayed reaches to targets without passing through a set of virtual barriers. We interleaved trials with barriers instructing a curved reach, trials with no barriers, and trials with barriers that did not interfere with making a straight movement. With the greater range of behavior required by this task, we found that neurons generally did not conform to the above two assumptions. For each well-modulated neuron (71/92), we took the most-preferred condition during the plan period, and checked whether the firing rate fell into the bottom 50% of the neuron's modulation range during the move period. This occurred for 42% of neurons, compared with 58% expected if plan and move tuning were completely

independent (assessed via bootstrap). That is, it was common for the condition that was most-preferred during plan to be among the least-preferred during move. To determine whether this was systematic across all conditions, we computed its "tuning pattern": the mean rate for each of the 24 conditions. On average, the tuning pattern for plan and move periods correlated only weakly: $r = 0.22$, indicating that tuning for plan and move are only modestly related. A consequence of this substantial misalignment of tuning patterns between plan and move is that whether a neuron appears to be primarily plan-related or primarily move-related will depend on exactly what conditions happen to be tested. It is also unclear how to reconcile this result with conceptions of motor planning in which a movement representation increases in strength until a threshold is broken and the represented movement begins. One possibility is that the representational scheme changes dramatically during these two periods. Alternately, plan activity may reflect the network moving to a state appropriate to initiate a more complex network response when the movement is triggered.

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