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COORDINATE FRAMES FOR REACHING IN MACAQUE DORSAL PREMOTOR CORTEX (PMD)

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In guiding the hand to a target, the brain converts the sensory representation of the target's location into a pattern of neural activity that actuates the reach. We directly assessed the coordinate frames employed by PMd for reaching. A monkey performed a delayed reach task. Four different initial eye and hand configurations were used. For two of them, the hand began at a common position, and gaze was directed 11° to the left or right of it. For the other two, the monkey fixated one spot while touching 11° to its left or right. On each trial the monkey looked and reached to one target in a 2x5 array (spanning 26° x46°, centered 17° above the start positions). 26 repetitions of each reach were performed. Neurons were recorded using a 96−electrode array in PMd. In one session, 64 single− and multi−units were isolated. During the delay period (500ms, beginning 250ms after target onset) 75% of units were tuned for target location. Of these, 85% were influenced by changing the initial position of the hand and 65% were influenced by the direction of gaze. 6% were unaffected by eye and hand position (ANOVA, $p<0.05$). In a 400 ms window centered on reach onset 50% of units were tuned. Of these, 94% were influenced by the hand's start position and 53% by gaze. 6% were unaffected by the initial configuration. In a separate analysis, we tested whether each neuron's responses were better aligned in hand−centered or in eye−centered coordinates by computing the mean squared difference between each pair of tuning curves. 69% (delay epoch) and 71% (move epoch) of the units were aligned better in hand−centered than in eye−centered coordinates. In contrast to area MIP, which represents reach plans in an eye−centered coordinate frame, PMd may not employ a clear extrinsic reference frame. Instead, PMd's representation of reach goals is sensitive to both eye and hand position.

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