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Heterogeneous coordinate frames for reaching in macaque PMd

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Visually-guided reaching necessitates a transformation from retinal coordinates to commands to the musculature. We investigated the coordinate frames (CFs) used to plan and execute reaches in the dorsal premotor cortex (PMd). Recordings were made with 4x4mm chronic arrays implanted in the caudal aspect of PMd of two macaques. Monkeys performed a delayed reach task, moving from a set of initial eye and hand positions to ten targets. We tested whether eye and/or hand position modulated the neural response, and whether neurons' response fields (RFs) were more tightly linked to the eyes or to the hand.
Of 89 neurons tuned for reach goal during the delay period, 72 were modulated by the position of the eyes, and 77 by the hand position (ANOVA, $p<0.05$). Furthermore, 52% of neurons' RFs were more tightly linked to the eyes than to the hand. This ratio reduced as the trial evolved, with 34% of neurons more eye-linked during the reach. We verified that these effects were not due to the imposed delay period, by using a no-delay task variant.
We asked if the CF of a neuron was consistently associated with any of its other properties. For example, neurons differ in temporal profile, with some cells most active after target appearance, and others active during the reach. No consistent relationship was observed between a neuron's timecourse and its CF. Neurons also differ in the source (eye or hand position) and degree of postural modulation (measured during a baseline epoch preceding target presentation). We could not reliably predict a neuron's CF from the postural signals it exhibited. Thus, we found no evidence for distinct subpopulations within PMd.
A particular CF cannot be unambiguously ascribed to most PMd neurons. Reach goals are encoded in a complex, heterogeneous manner in this area. Although it is hard for an experimenter to decipher what the activity of a particular PMd neuron "represents", this heterogeneous scheme may provide a rich substrate for flexible movement.

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