Neural Basis of Reach Preparation

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Our seemingly effortless ability to reach out and swat a fly or grab a cup belies the sophisticated neural computations at work in our nervous system. It has long been recognized that before moving we somehow prepare neural activity such that, when called upon, the desired movement unfolds. But the goals of such movement preparation and the underlying neural mechanisms remain poorly understood. To address this problem, our recent electrophysiological and computational investigations have focused on how premotor cortex in the rhesus monkey helps prepare movements, with a particular emphasis on understanding how this is accomplished on a single-trial basis [1]. Results suggest that the brain is attempting to optimize preparatory neural activity [2] and can delay movement until this activity is sufficiently accurate [3]. Consistent with this view, even minor fluctuations (inaccuracies) in preparatory activity result in altered movements [4]. To further investigate single-trial neural behavior we note that spiking activity during motor preparation exhibits dynamics beyond that driven by external stimulation, presumably reflecting the extensive recurrence of neural circuitry [5]. We have been investigating methods for capturing the dynamics from (96 channel) simultaneous neural recordings, visualizing low-dimension state-space neural trajectories, and relating these preparatory trajectories to the resulting arm movement kinematics. Characterizing these dynamics may reveal important features of neural computation, as well as provide novel perspectives on how to interpret single-neuron preparatory activity that appears to evade interpretation in traditional 'representational' terms [6-8].

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