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POSTER AND SHORT ORAL PRESENTATION

# Ensemble activity underlying movement preparation in prearcuate cortex

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Movement preparation allows the rapid and accurate execution of voluntary movements, and can be influenced by factors that may change from moment to moment, such as attention and differences in stimulus properties. Consequently, movement preparation unfolds differently across many repetitions of the same movement. Averaging neural responses across many repetitions is necessary to interpret single-cell recordings, but diminishes our ability to characterize the dynamics of the underlying process. However, simultaneous recording from populations of neurons allows dynamics of movement preparation to be estimated on single trials. Our goal is to characterize these dynamics, to gain insight into the process underlying movement preparation. In the oculomotor system, the dynamics of movement preparation in individual cells are typically described using a rise-to-threshold model. As activity at the location on the cortical map corresponding to the target location increases, the saccade to that target is considered more "prepared", and the saccade can be initiated once activity crosses a threshold (Hanes & Schall, 1996). Reaction times are shorter when cells increase their firing rates to this threshold more rapidly. However, this relationship has only been studied in individual cells with saccade targets in their response field. During behavior, the brain must combine input from populations of cells with wide ranges of response field positions relative to the upcoming saccade. To study the dynamics of movement preparation, we took an alternative approach that permits us to examine movement preparation by integrating information from a larger population of neurons with heterogeneous response fields. Here, we recorded peri-saccadic activity from ensembles of neurons in the prearcuate cortex in two monkeys. While monkeys performed visually-guided eye movements, we measured firing rates of a population of oculomotor neurons using a 96-electrode "Utah" array (Blackrock Microsystems, Salt Lake City, UT). Using the simultaneity of the neural responses recorded, we correlated trial-by-trial variations in population activity with the monkey's latency to saccade. In our population analysis, each neuron's firing rate describes a dimension in a high-dimensional firing rate space. The activity of the population evolves over the course of a trial, tracing out a trajectory within this high-dimensional space. These trajectories vary from trial-to-trial, but follow a stereotyped path. On individual trials, we found that the further along this path the population activity is when the monkey receives the go cue, the shorter the saccade

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latency. In both monkeys, this population measure accounted for more variance in reaction time than a measure of firing rate increase in individual neurons. Further, this relationship between prearcuate responses and saccadic reaction times was similar to that observed for reach reaction times and population dynamics in PMd (Afshar et al., SfN 2008). This suggests that some aspects of the neural strategy underlying movement preparation may be common to both systems. Our framework for analyzing neural population activity and dynamics should permit new extensions of single-neuron-level models, and may offer further insight into general mechanisms of movement preparation across motor systems.

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