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Presentation Abstract

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Abstract: Reaching requires coordinating many processes, including determining where and when to move and monitoring the movement in order to make corrections as needed. These corrections can be caused by external perturbation of the arm or a change in the reach goal. Here, we investigate the process by which one changes from one reach goal to another, either before or after initiating a reach. We ask how determining where to reach interacts with the process of determining when to reach. We look to see, both behaviorally and neurally, whether there is a signature of “commitment” to a given reach direction: what determines whether a monkey can change an upcoming behavior before executing, versus being forced to correct mid-movement?
We trained Monkey K (rhesus macaque) to perform a delayed reaching task in which the pre-cued target occasionally jumped locations at a random time after the go cue but before the reach was initiated. The monkey had to reach to the illuminated target for a juice reward. If the target jump occurred long before the reach was generated (>150ms prior to movement onset), then the monkey was able to take this information into account before initiating the movement. However, if the target jump occurred close to the time of movement (<100 ms prior to movement onset), he made a “false start” in the direction of the first (incorrect) target. This implies that he had already committed to generating the reach by the time the information about the target jump arrived in motor generation areas. He then needed to correct mid-reach to acquire the new target.

We then examined how neural state evolves during these “target jump” trials. We recorded neural activity using two chronically implanted 96-electrode arrays in motor and dorsal premotor cortex. We asked whether we could use the monkey’s neural activity to predict whether the monkey would initiate his reach in the direction of the first or second target. To do this, we performed a binary classifier of the initial reach angle against the FRs in the 40 ms bin before the target jump using Linear Discriminant Analysis. We were able to correctly classify an above-chance percentage of trials (78 +/- 17% correct, mean +/- std across 8 switch pairs). The monkey’s neural state predicts when the monkey has committed to a reach, even before the reach has begun. If we moved the target before the monkey committed to making the original (incorrect) reach, then he was able to initiate his reach in the correct direction; otherwise, he had to correct his actions mid-reach instead.

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MOTOR CONTROL

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