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Presentation Abstract

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Title:	Lack of evidence for inhibitory gating in monkey M1
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Authors:	***M. T. KAUFMAN**[1], M. M. CHURCHLAND[2,1], K. V. SHENOY[2,1,3]; [1]Program in Neurosci., [2]Dept of Elec. Eng., [3]Dept. of Bioeng., Stanford Univ., Stanford, CA
Abstract:	M1 is thought to be largely responsible for movement execution. Given that premotor cortex projects heavily to M1, and that it exhibits firing rate modulation during the preparation of movement, how does the brain prevent preparatory activity from driving movement? One possibility is that preparatory activity never escapes premotor cortex, perhaps because premotor output neurons remain strongly inhibited during the preparatory period. If this were true, we would expect that firing rates of premotor inhibitory neurons would be high during preparation then low during movement, to correctly time output to downstream areas (including M1). However, we have previously shown evidence inconsistent with this hypothesis in dorsal premotor cortex (PMd; Kaufman et al, SFN 2008). An alternative hypothesis is that there is strong inhibition within M1 during movement preparation, and this serves to prevent M1 from acting on premotor input. To test this hypothesis, we performed single-unit neural recordings in M1 of two monkeys performing a delayed-reach task. In this task, a target appeared while monkeys fixated. The monkeys were required to withhold movement until a go cue, then reach to the target. We used the recorded waveform shape to distinguish putative inhibitory interneurons from pyramidal cells (25/36 putative

inhibitory/excitatory neurons for monkey J; 17/19 for monkey N). The M1 gating hypothesis predicts that inhibitory activity should be high during the preparatory period (to prevent motor output) and low during movement (to permit output). We instead found the opposite pattern: M1 inhibitory activity was on average near baseline during the preparatory period, and increased during the movement (mean 17 spk/s during baseline to 44 spk/s peak for monkey J; 18 to 31 for monkey N). Excitatory activity rose less from baseline to movement (from 13 to 19 for J; 18 to 29 for N). Peak inhibitory activity occurred near movement onset, similar to PMd. Nor did we find a distinct subset of inhibitory neurons that exhibited the hypothesized pattern of activity. These results suggest that movements may be gated further downstream, such as in the spinal cord. Alternatively, some fundamentally different mechanism may prevent preparatory activity from producing movement. One possibility is that the brain exploits the fact that the neuron to muscle projection is many-to-one. This could allow neural activity to change during preparation without causing an immediate change in muscle activity.

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