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Presentation Abstract

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| Title: | Putative interneurons respond more rapidly than pyramidal cells in monkey premotor cortex |
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| Authors: | ***M. T. KAUFMAN**[1], M. M. CHURCHLAND[1,2], K. V. SHENOY[2,1]; [1]Neurosci., [2]Elec. Eng., Stanford Univ., Stanford, CA |

Abstract: In dorsal premotor cortex (PMd), as in all neocortex, excitatory and inhibitory neurons possess different intrinsic dynamics: inhibitory interneurons have faster membrane time constants than excitatory pyramidal cells (Kawaguchi 1995). However, it is not clear whether these intrinsic differences in time constants should translate into differences in dynamics when neurons are embedded in a recurrent, heterogeneous network. Here, we used spike waveform duration to identify neurons recorded from 3 rhesus monkeys as putative interneurons or putative pyramidal cells. Neurons in PMd show modulation of their activity both during movement and during a plan period, after an instructive cue but before a go cue. We used two methods to examine temporal dynamics at the onset of planning in a delayed-reach task. We first used a measure based on the mean firing rate. At each time point, we took the depth of tuning as the difference in firing rate between the most and least responsive conditions. This measure was averaged across neurons (i.e., across all putative interneurons and across all putative pyramidal cells), then we found the time at which the average depth of tuning reached half its maximum. We determined that although this point was indeed earlier for putative interneurons than for pyramidal cells, this difference was quite small (monkey J: 115 vs. 156 ms, $p < 0.001$; monkey G; 47 vs. 53 ms, n.s.; monkey H: 61 vs. 65 ms, n.s.). To obtain the second measure of temporal dynamics, we employed the Fano Factor (FF). We previously reported that across-trial neural variability in PMd (as measured by the FF) declines following the instructive cue, and appears related to the time-course of motor planning. Here we found that putative interneurons showed a substantially more rapid decline in FF than did pyramidal cells (monkey J: 100 vs. 211 ms, $p < 0.001$; monkey G: 108 vs. 144 ms, $p < 0.01$; monkey H: 101 vs. 170 ms, n.s.), controlling for the rate differences between the cell types. That is, pyramidal cells take much longer than interneurons (~72 ms) to shed excess variability during motor planning. In contrast, the small time difference observed in the development of tuning depth (~17 ms) was of similar magnitude to previously-reported differences in membrane time constants. This implies that the difference in FF time-course is not due to limitations of neurons' slew rates. In sum, putative interneurons indeed show faster dynamics than pyramidal cells, but this difference is substantially larger in the FF than it is in the time required for tuning to develop. Future work will be needed to determine whether these time-course differences stem from biophysical time constants or some other network property.

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