Ensemble representation of time: Interhemispheric communication involved?

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Abstract

Any motor behavior has both spatial and temporal components. We decoded timing information from the activity of large (approximately 300 neuron) cortical ensembles. Two rhesus monkeys were trained to self-time button presses. Multielectrode recordings from primary motor, dorsal premotor, ventral premotor and posterior parietal cortex showed near-linear firing rate modulations (both ramp-up and ramp-down) during the delay period of the task preceding movement. Combining information from many neurons allowed us to obtain accurate predictions of elapsed time and of the time until movement initiation several seconds prior to movement. Both contralateral and ipsilateral hemispheres contributed to these predictions. Moreover, the contribution from the ipsilateral hemisphere increased when one of the monkeys was trained to perform the task with their left arm after first learing the task with their right arm. These results were corroborated with local field potentials and show a highly distributed representation of time information in the cortex. Furthermore these decoded timing signals can be used to improve brain-machine interfaces (BMI) by allowing the precise timing of movement initiation for gating voluntary movements..