Correlations between Pairs of Neurons and Behavior in the Frontal Cortex During Smooth Pursuit Eye Movements

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In response to repeated presentations of an identically moving target, both neural activity and the eyes' smooth movement display considerable variation. We have previously demonstrated that the firing rate of individual cortical neurons describes a sizeable fraction of this variation, suggesting a direct role for the neurons in driving the trial-to-trial fluctuations of the eye movements. Intuitively, any pair of neurons that explains a large portion of the behavioral variance ought to have correlated activity. We have formalized this notion in an analytical model, and tested the model predictions against neural data. Our data set consisted of 104 pairs of neurons in the frontal eye fields of two monkeys engaged in a traditional step-ramp smooth pursuit task. Our model is a simple linear framework describing the relationship between the behavioral variance explained by a set of neurons, the correlation between the neurons, and the number of neurons in the active population. Neural activity is treated as a set of dependent random variables, and the behavior as their sum. Quantitative analysis suggests, in contrast to the simple intuition, that there is no relationship between the behavioral variance explained by the pair of neurons and the co- variation of neural activity.

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References
[1] Neural response variability. A. Scientist and O. Colleague, *Nature Neuroscience* 4(23):1800-1810, May 2008.