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Title: The timecourse of neural variability in visual area MT

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We examined the magnitude and timecourse of neural variability in the middle temporal visual area (MT). This was done for two datasets. The first was collected while the monkey viewed plaid stimuli and made a transparent versus coherent judgment. The second was collected while the monkey viewed random dot stimuli and made a direction judgment. Neural variability was assessed using a variant of the Fano factor. For a given 50 ms time window, we counted the number of spikes observed for each trial. For each neuron / condition, we computed the variance and mean of this count. The variance was plotted versus the mean, with one point per neuron / condition (7031 for the first dataset, average trial-count of 15; 89 for the second, average trial-count of 88). The Fano factor was defined as the slope of the linear fit. This was computed as a function of time, by sliding the 50 ms window in 25 ms steps. The Fano factor underwent a sudden decline following stimulus onset: from ~1.4 to ~1.0. This decline was rapid, spanning only ~50 ms. Critically, the decline was not secondary to changes in mean rate. It was preserved even when the distribution of firing rates was matched for all time-points. It was also preserved if we restricted analysis to cases with little change in mean rate (e.g., responses to non-preferred directions). The decrease in variability is thus probably not due to cell-intrinsic mechanisms, unless those mechanisms are independent of changes in mean rate. We suggest that the decline in variability is most likely a network property: that the 'underlying' firing rate is not identical across trials, but becomes more consistent following stimulus onset. This could occur if recurrent circuitry exhibits more stable dynamics when driven by an input that when left 'floating'. We have applied a similar interpretation to the decline in neural variability observed in premotor cortex. That decline spans ~200 ms, and appears to be related to recurrent computations underlying motor planning. The much more rapid decline observed in MT suggests a relation to simpler, perhaps purely local, recurrent computations. The nature of those computations is unclear from our data, but could be related to the phenomenon of 'gain control' or to center-surround effects.

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