Supplemental Material for:

Microsaccadic Suppression of Visual Bursts in the Primate Superior Colliculus

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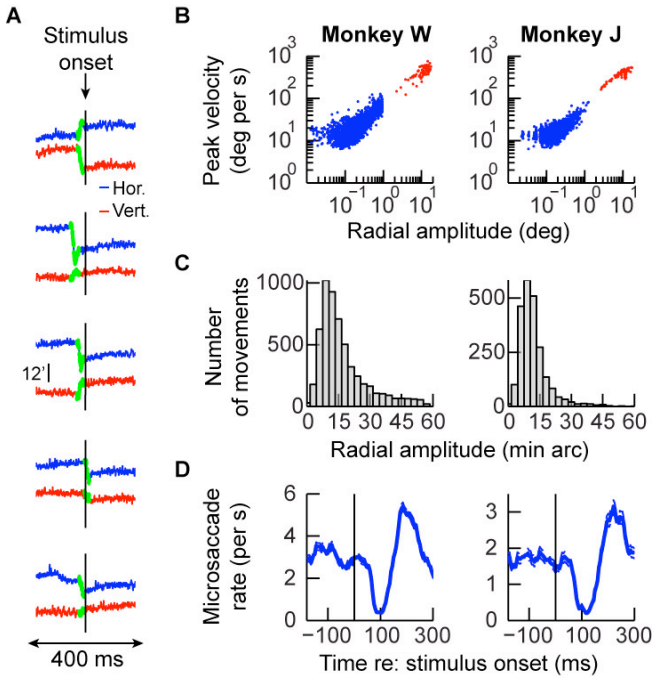

Figure S1 Confirming microsaccade detection and characteristics during the visual stimulus task. **A,** Horizontal (blue) and vertical (red) eye position traces from five sample trials in monkey W during the visual stimulus task. These trials are the five trials that were associated with the weakest visual bursts in Fig. 1B of the main text. Microsaccades are highlighted in green. As can be seen, microsaccades occurred in different directions, and they were characterized by a step-like change in eye position as is well known. The vertical scale bar (12' or 0.2 deg) applies to all the shown trials. **B,** Microsaccades occurring around stimulus onset in the visual stimulus task (occurring from -200 ms to +150 ms) are plotted as blue symbols for each monkey on a peak-velocity versus amplitude graph. The red symbols are larger voluntary saccades selected from a representative session (collected in the RF mapping task), and they are included on the same graphs to show that microsaccades are the small-amplitude extension of the known saccadic 'main sequence' relationship (e.g. Zuber & Stark, 1965). **C,** The amplitude distribution of the microsaccades in **B** is shown for each monkey. This is similar to previous distributions with similar fixation stimuli (e.g. Hafed et al., 2009). **D,** Microsaccade rate as a function of time in the visual stimulus task. Microsaccades occurred with a relatively constant frequency in the period around stimulus onset (this is the relevant period in this study because it includes the time of stimulus onset). Later after stimulus onset, microsaccades exhibited a reduction followed by an increase in frequency, again as has been observed in numerous studies (e.g. Rolfs et al., 2008). Error bars, when visible in this panel, indicate s.e.m.

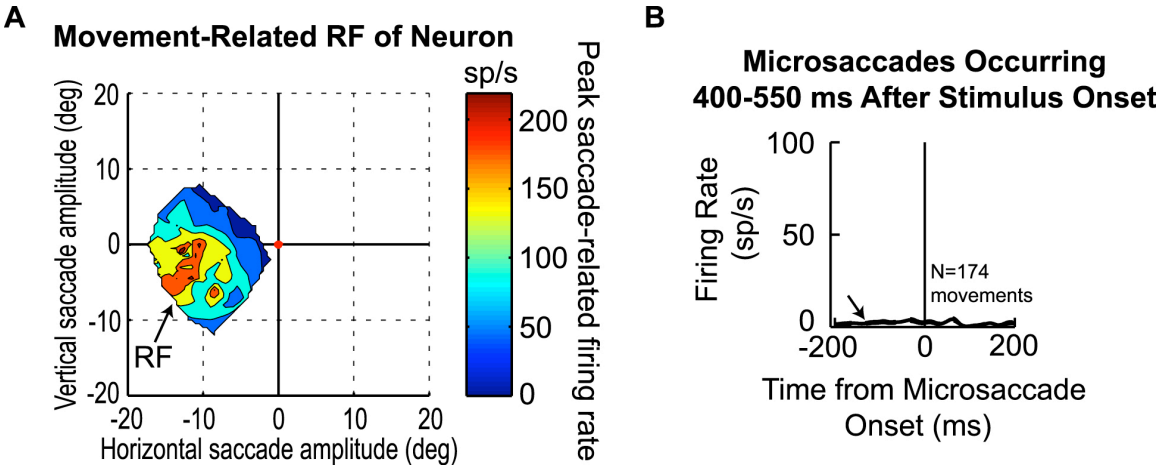

Figure S2 Independence of microsaccadic suppression of peripheral visual bursts in the neuron of Fig. 1 from movement-related modulations by the neuron. **A,** Movement-related RF of the neuron of Fig. 1. For the same mapped locations in Fig. 1A, we plotted the peak discharge of the neuron when the monkey generated saccades to these locations. The neuron exhibited saccade-related activity for movements to peripheral targets in the lower left quadrant, and it was not active for small saccades. Thus, the movement-related RF of the neuron did not encompass foveal locations associated with microsaccades (red blip at the origin). **B,** Peri-microsaccadic activity of the same neuron in our visual stimulus task but during a latent period well after all sensory transients had subsided, and also well before stimulus offset at trial end. For the same trials in Fig. 1C, we detected all microsaccades occurring between 400 ms and 550 ms after stimulus onset, and we plotted the average activity of the neuron aligned on microsaccade onset. The neuron did not exhibit appreciable movement-related activity for microsaccades, consistent with the RF map of **A**. Separation of the microsaccades into ones towards the neuron's RF and opposite it also did not change this result (data not shown).

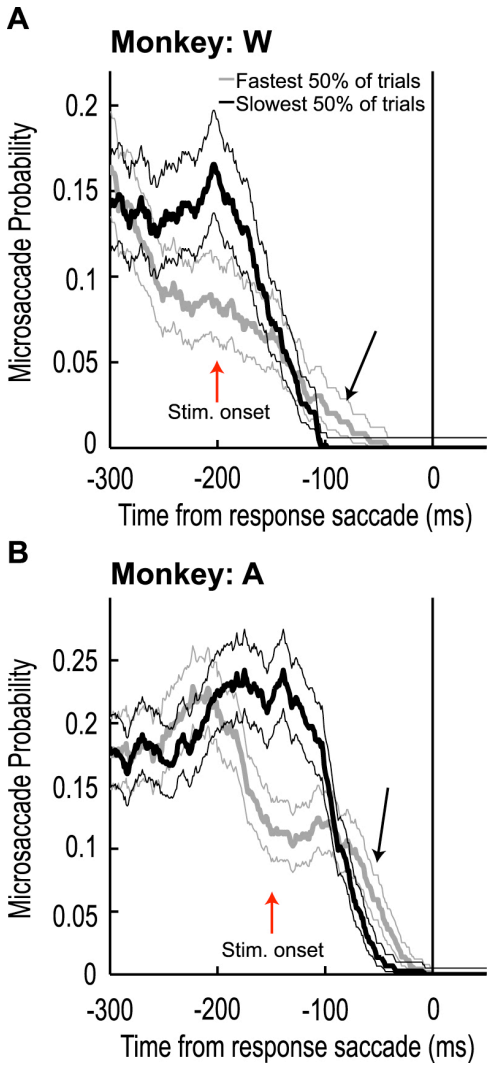

Figure S3 Microsaccadic prolongation of reaction times in Fig. 3 was not fully explained by a motor conflict between microsaccades and response saccades. It may be argued that our behavioral results are due to a motor conflict between microsaccades and temporally proximal saccades. To rule this out, we analyzed microsaccade onset timecourses relative to the response saccade onset. **A, B,** Likelihood of observing a microsaccade in the reaction time task as a function of time from response saccade onset in monkey W (**A**) and monkey A (**B**) - obtained by calculating the frequency of trials containing microsaccades within a 50-ms sliding window. In both panels, black indicates the trials with reaction times slower than the median; gray indicates trials with reaction times faster than the median. Thin lines indicate 95% confidence intervals. This format of plotting the data is similar to the one used previously by Bosman et al. (2009), but aligned on response saccade onset time. As can be seen, microsaccade frequency decreased leading up to response saccade onset for both fast and slow reaction time trials. However, the decrease occurred sooner for slow trials than for fast trials (black arrow). That is, there were actually fewer microsaccades near response saccade onset on slow trials than on fast trials, ruling out a motor conflict between microsaccades and temporally adjacent response saccades as the explanation for the increase in reaction times in Fig. 3. In both panels, also note how microsaccade frequency becomes most different between fast and slow reaction trials at a value for each monkey consistent with when the stimulus appeared (on average) relative to saccade onset (red arrows). In other words, fast trials are associated with fewer microsaccades *around* stimulus onset than slow trials. This again indicates that the interaction between microsaccades and reaction times that we observed in Fig. 3 was mediated by the temporal proximity of microsaccade onset to stimulus onset, not to response saccade onset.