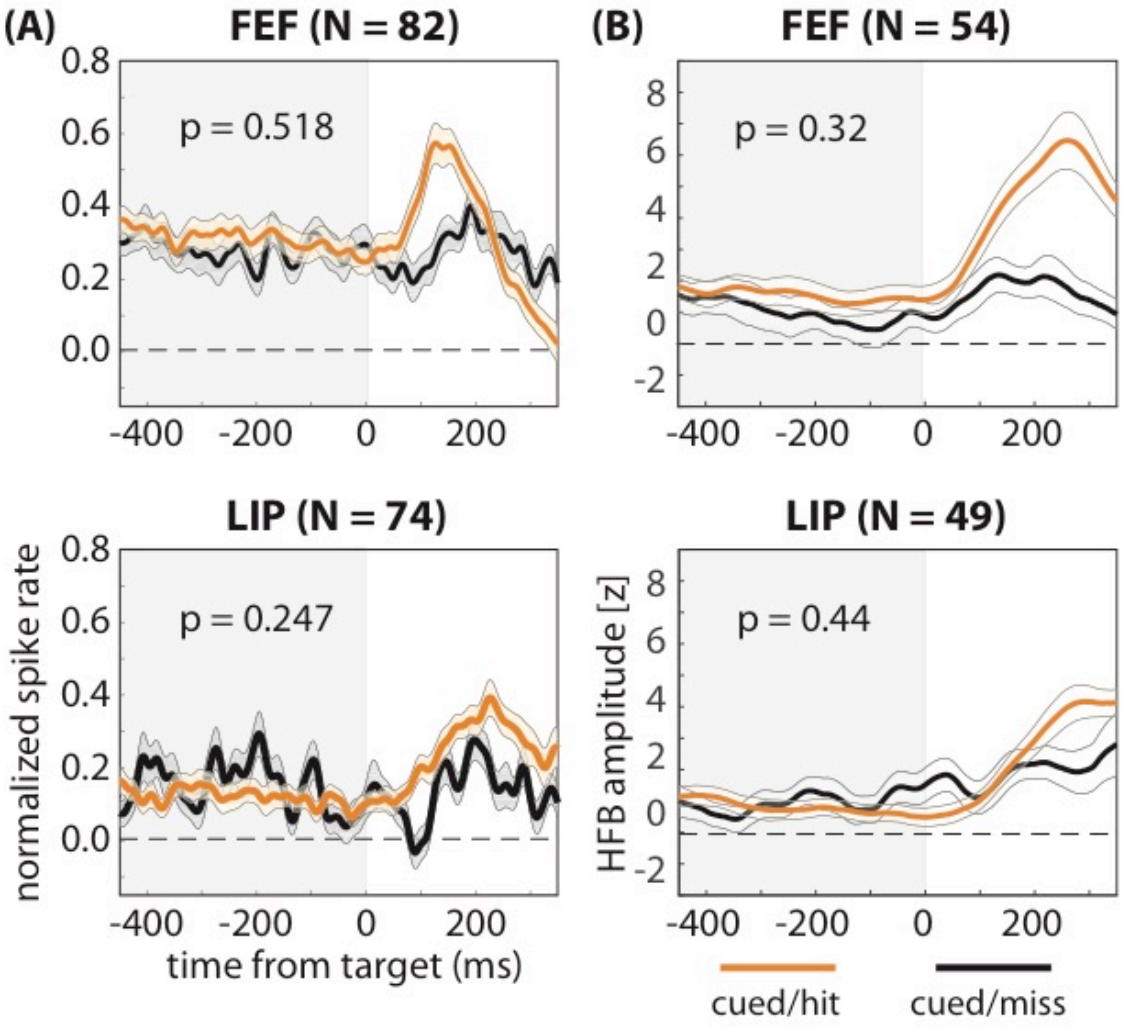
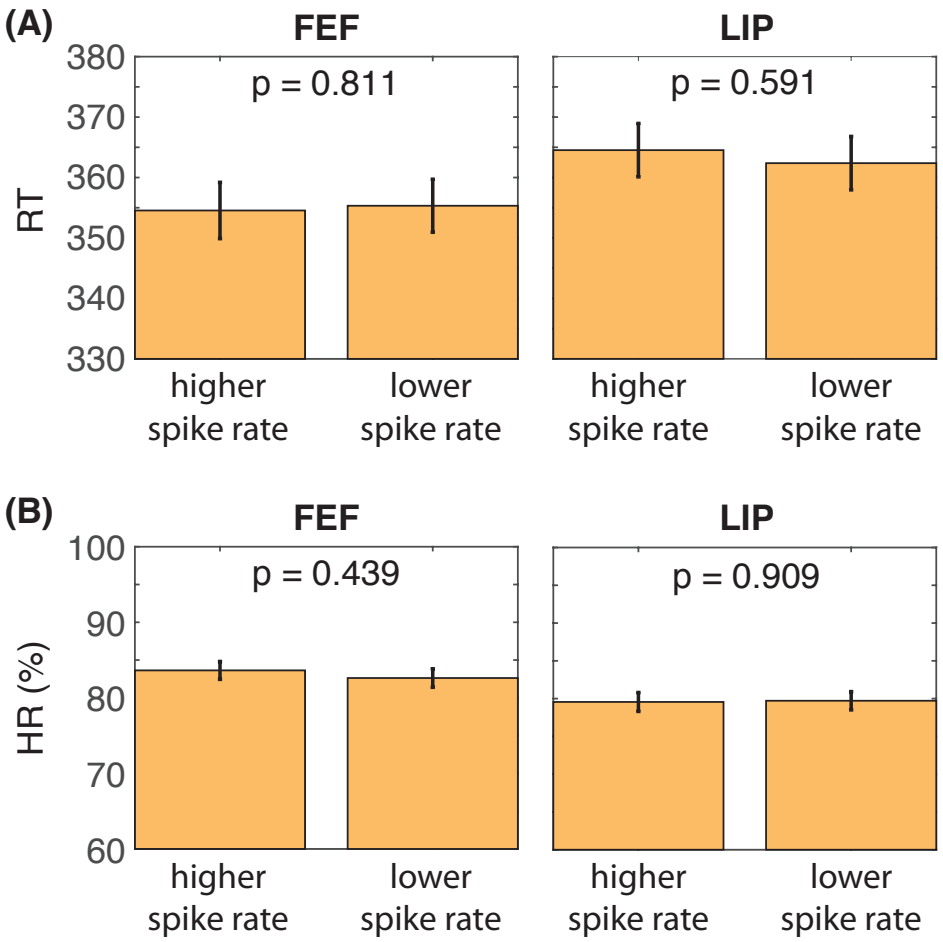
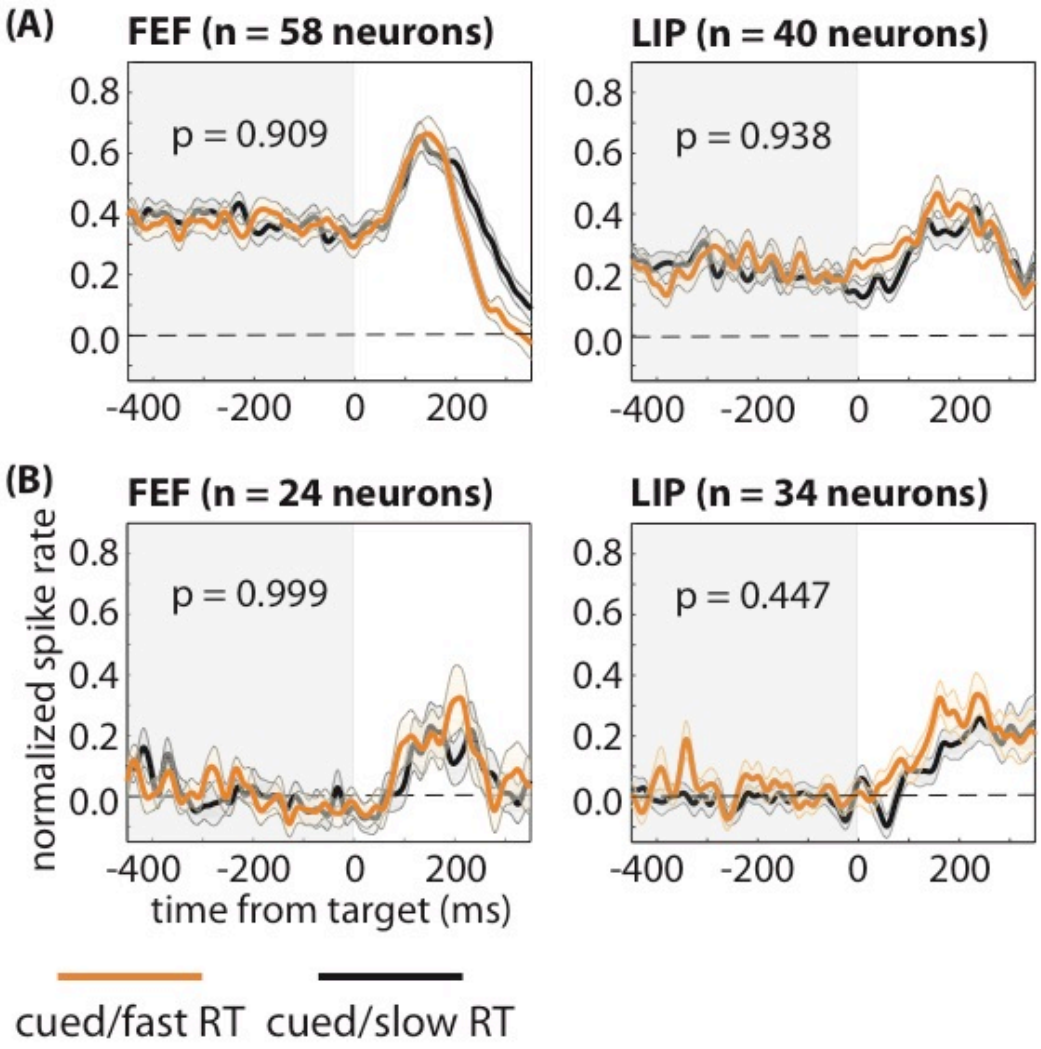
SUPPLEMENTAL FIGURES



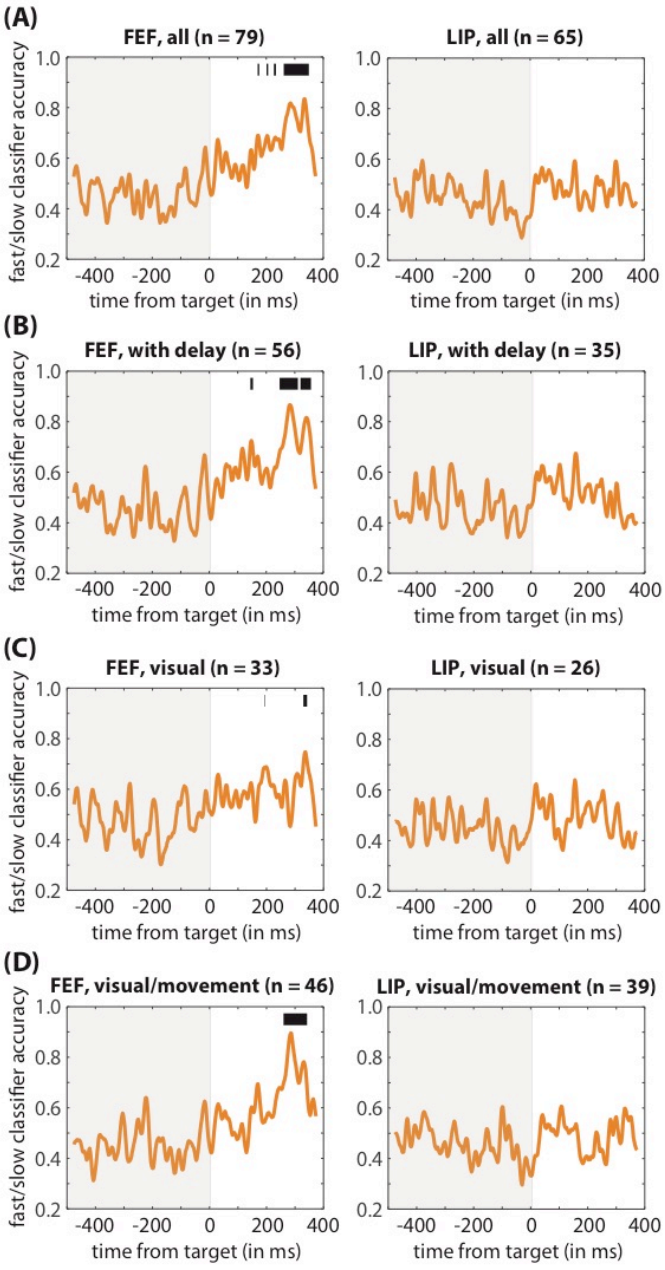
Supplemental Figure 1. *Differences in the magnitude of pre-target spiking activity are not associated with whether a trial resulted in either a hit or a miss.* Related to Figure 1 and Figure 3. There were no observed differences between trials that resulted in either hits or misses (i.e., when RFs overlapped the cued location) between either **(A)** spike rates averaged across neurons or **(B)** high-frequency band (HFB) activity averaged across sessions (i.e., a proxy for population spiking). The shaded area around each line represents the standard error of the mean.



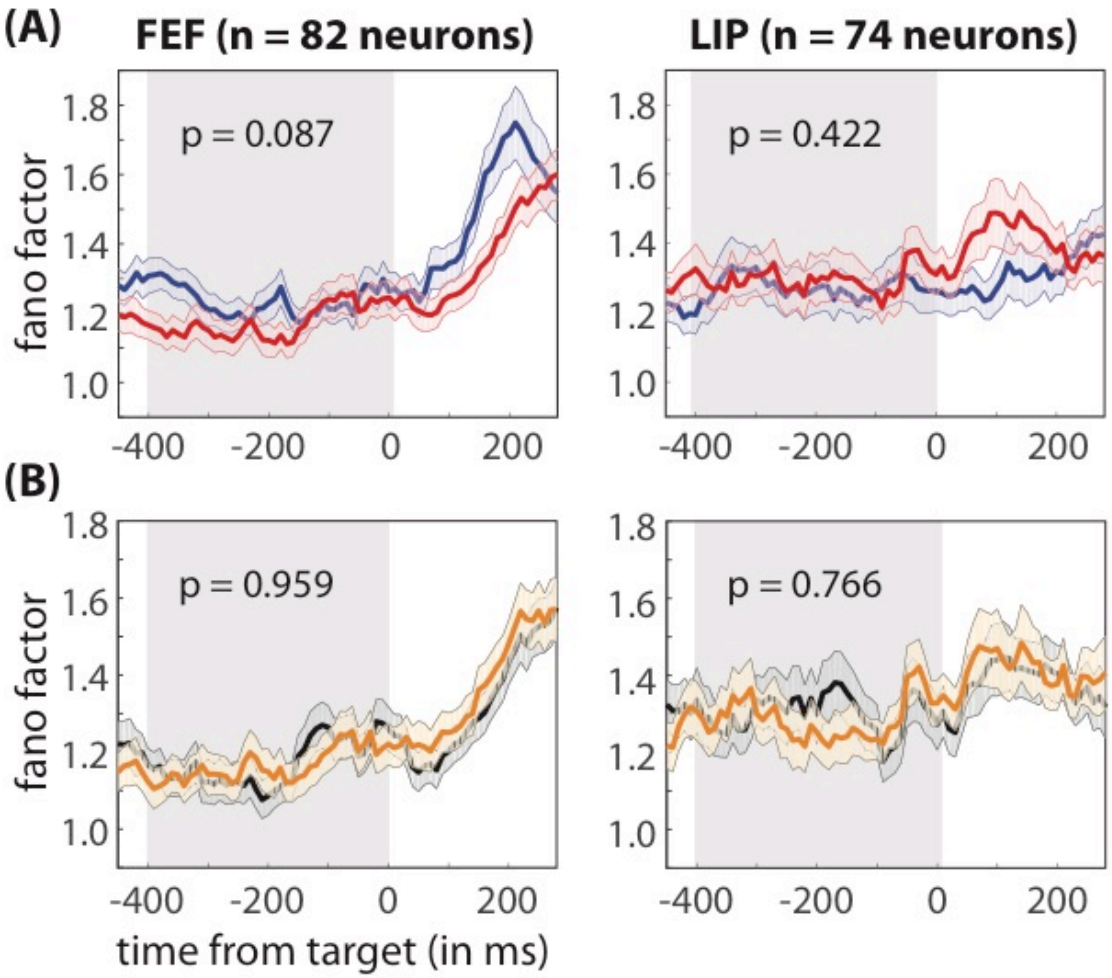
Supplemental Figure 2. *Behavioral performance by spike rate.* Related to Figure 1. Trials were binned based on the median spike rate when the receptive field overlapped the cued location into higher and lower spike rate bins, separately for each neuron (n = 82 neurons for FEF, n = 74 neurons for LIP). **(A)** RTs (i.e., response times) are shown for the higher and lower spike rate bins (i.e., relative to the median spike rate), averaged across neurons in either FEF or LIP. **(B)** HRs (i.e., hit rates) are shown for the higher and lower spike rate bins, averaged across neurons in either FEF or LIP. There was no statistically significant difference in RT or HR between trials with spike rates either greater or less than the median spike rate.



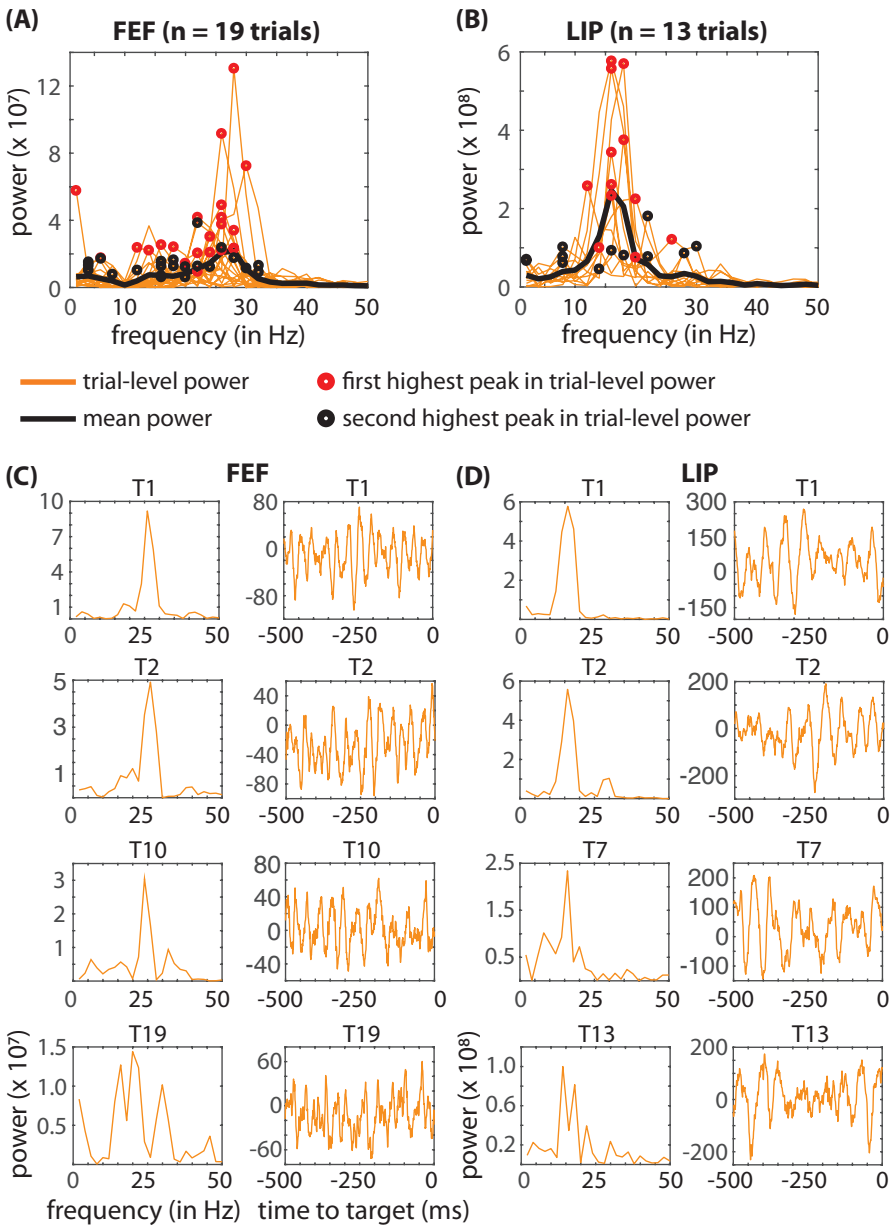
Supplemental Figure 3. *Spike rate at the cued location is not associated with behavioral performance (i.e., fast- and slow-RT trials) for neurons with **(A)** or without **(B)** a significant increase in spike rate during the cue-target delay.* Related to Figure 1. The shaded area around each line represents the standard error of the mean.



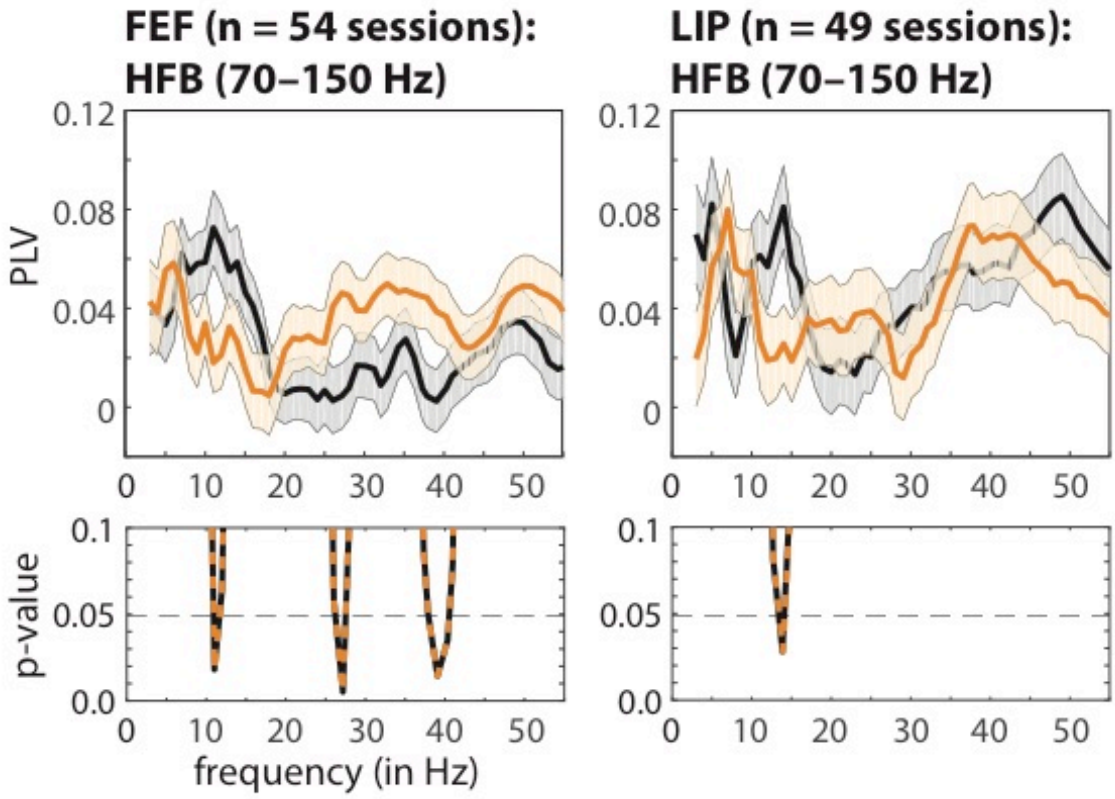
Supplemental Figure 4. *Classifiers are not able to predict behavioral outcome based on pre-target spiking activity.* Related to Figure 1 and Figure 2. Logistic regression classifiers were trained to predict whether trials resulted in either a faster or a slower response time (RT), based on spiking activity from pseudo-populations of neurons in either FEF or LIP. The accuracy of these classifiers at different time points relative to target presentation is shown for **(A)** all neurons, **(B)** cells with significant delay activity, **(C)** visual neurons, and **(D)** visual movement neurons. The black dashes above the accuracy plots represent statistical significance ($p < 0.05$). We excluded neurons with fewer than 30 correct trials when both the target occurred at the cued location and the receptive field overlapped with the cued location.



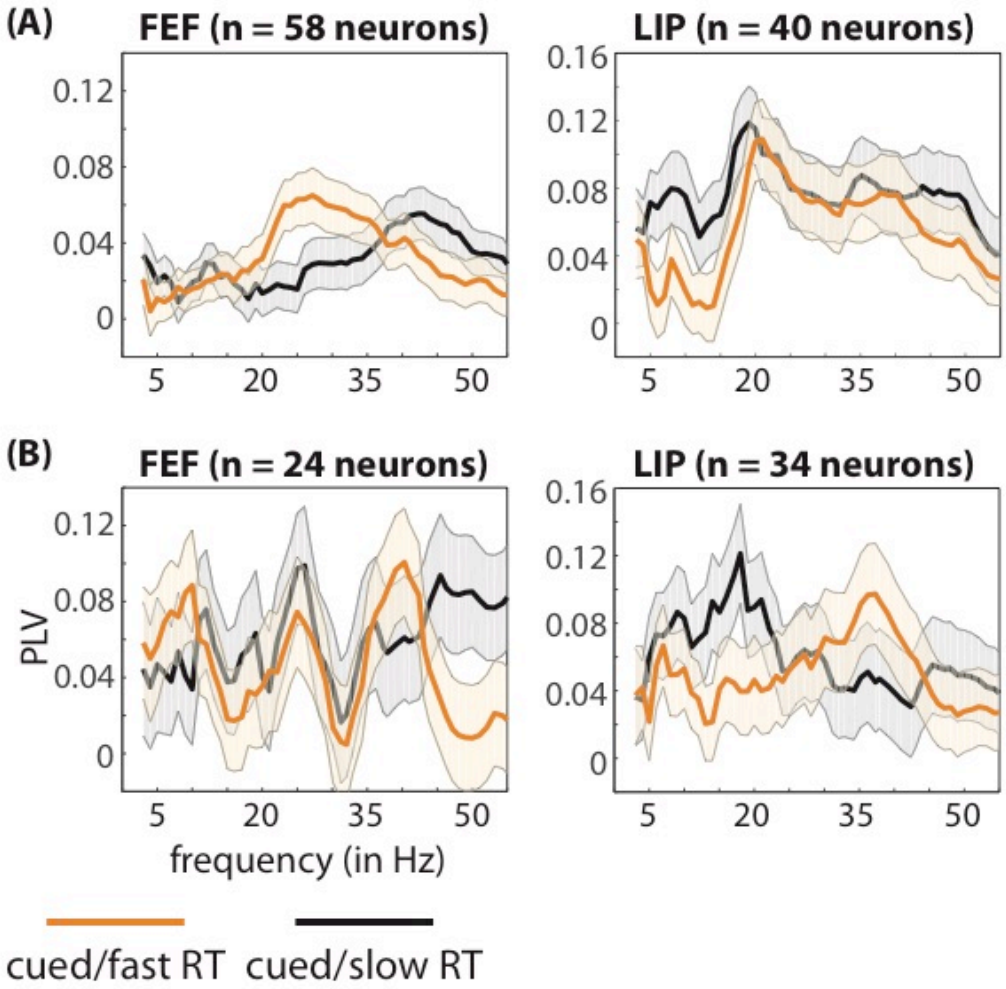
Supplemental Figure 5. *Differences in pre-target spike-count variability are not associated with differences in behavioral performances.* Related to Figure 1. There was no difference in spike count variability (i.e., Fano factor) based on either **(A)** attentional condition (i.e., cued versus non-cued) or **(B)** behavioral performance (i.e., fast versus slow RTs). The shaded area around each line represents the standard error of the mean.



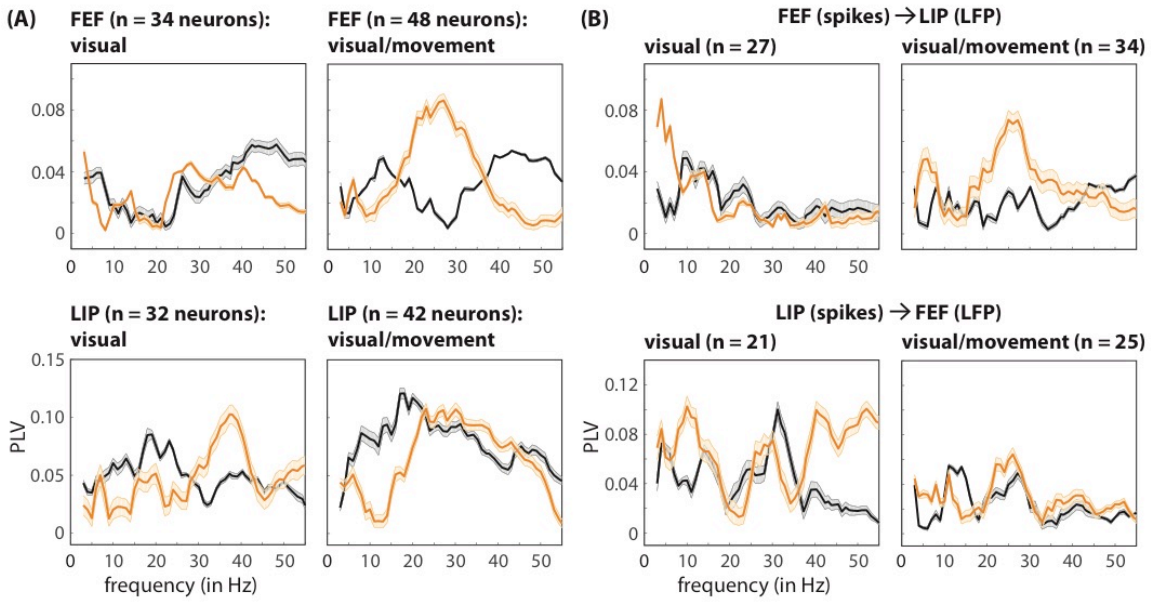
Supplemental Figure 6. *Trial-level data from single recording sessions.* Related to Figure 4. **(A)** and **(B)** show the power spectra from each trial (orange lines) and the mean across sessions (black line). The highest and second highest peaks in the power spectra from each trial are indicated with red and black circles, respectively. **(C)** and **(D)** provide examples of the trial-level power spectra and the associated trial-level LFPs. We have included trials with the highest power (T1 and T2) at **(C)** the beta peak in FEF and at **(D)** the alpha peak in LIP. We have also included trials at the middle of the power distributions (T10 or T7), and trials with the lowest power (T19 or T13).



Supplemental Figure 7. *Different oscillatory patterns in pre-target population spiking activity are associated with either faster or slower response times.* Related to Figure 5. We compared the consistency of oscillatory phase at peaks in high-frequency band (HFB) activity, during the cue-target delay, across fast- (orange lines) and slow-RT trials (black lines). These results are comparable to those associated with local spike-LFP phase coupling (Figure 5). The p-values for between-condition comparisons are represented below each panel. The shaded area around each line represents the standard error of the mean.



Supplemental Figure 8. *Spike-LFP phase coupling for trials that resulted in either faster or slower RTs after binning neurons based on the **(A)** presence or **(B)** absence of a significantly elevated spike rate during the cue-target delay (i.e., significant delay activity).* Related to Figure 5. Increased beta synchronization in FEF during fast-RT trials (see Figure 5) seems to be restricted to neurons with significant delay activity, while decreased alpha synchronization in LIP during fast-RT trials (see Figure 5) seems to be associated with both cell types (i.e., neurons either with or without significant delay activity). The shaded area around each line represents the standard error of the mean.



Supplemental Figure 9. *Behaviorally relevant differences in oscillatory patterns of spiking activity are not attributable to differences in oscillatory power.* Related to Figure 6 and Figure 7. The reliability of phase estimates increases with increasing oscillatory power. This may lead, for example, to spurious between-condition differences in spike-LFP phase coupling if there are between-condition differences in oscillatory power. Here, differences in spike-LFP phase coupling, at both the **(A)** local and the **(B)** network levels, continued to be observed after a stratification procedure that equated power across trials that resulted in either faster or slower response times. The shaded area around each line represents the standard error of the mean associated with repeated iterations of the stratification procedure.