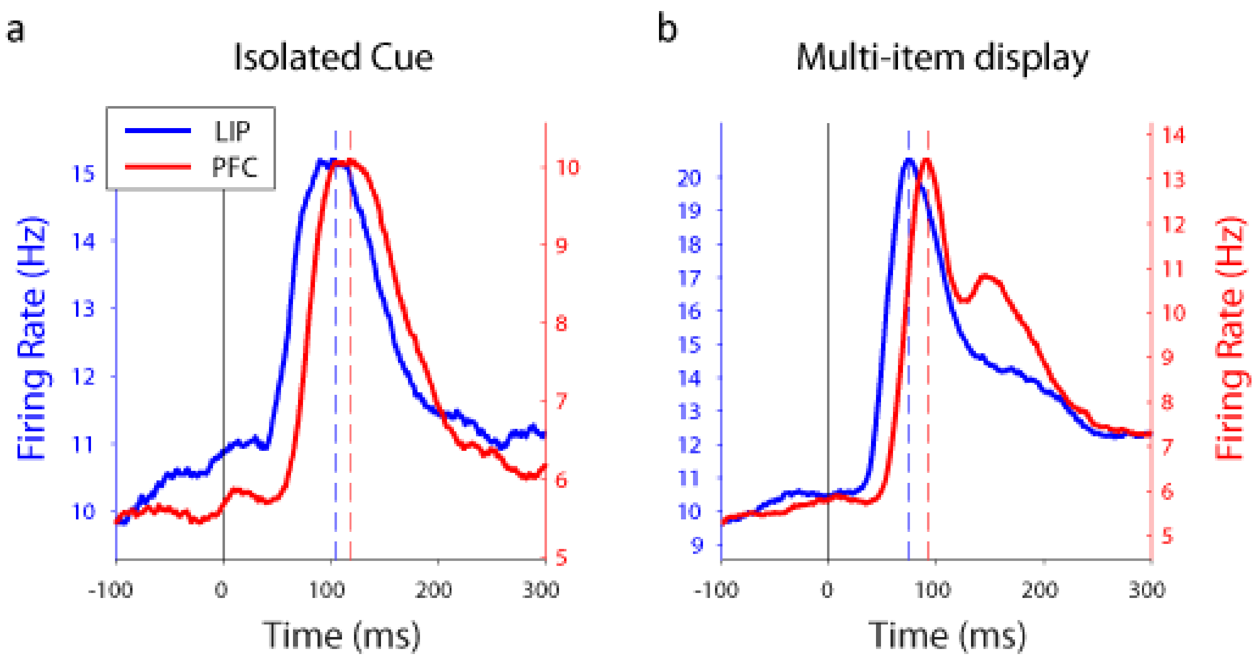
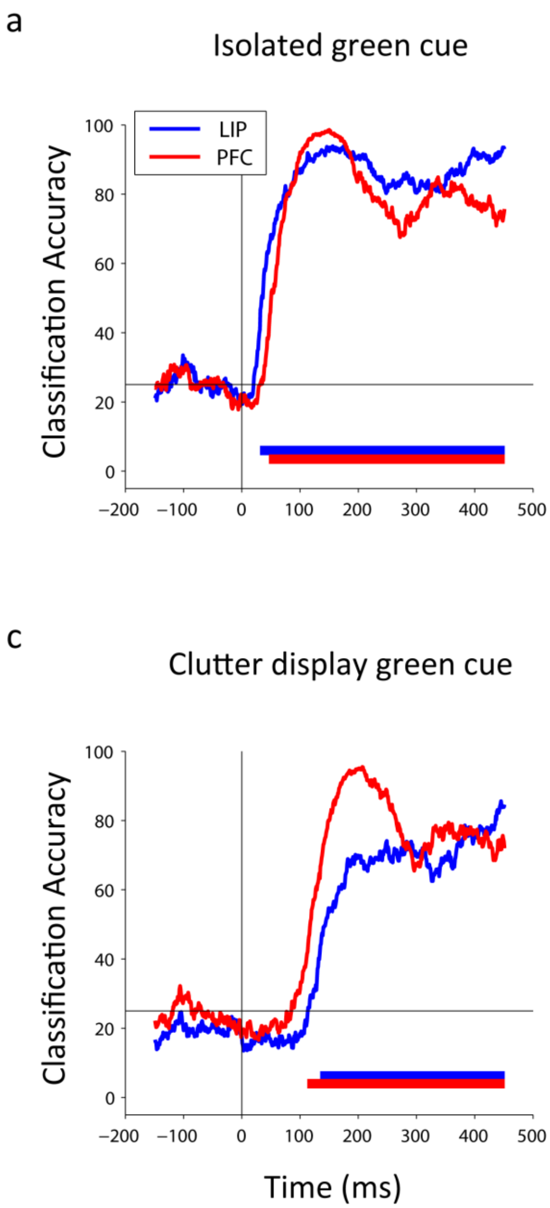
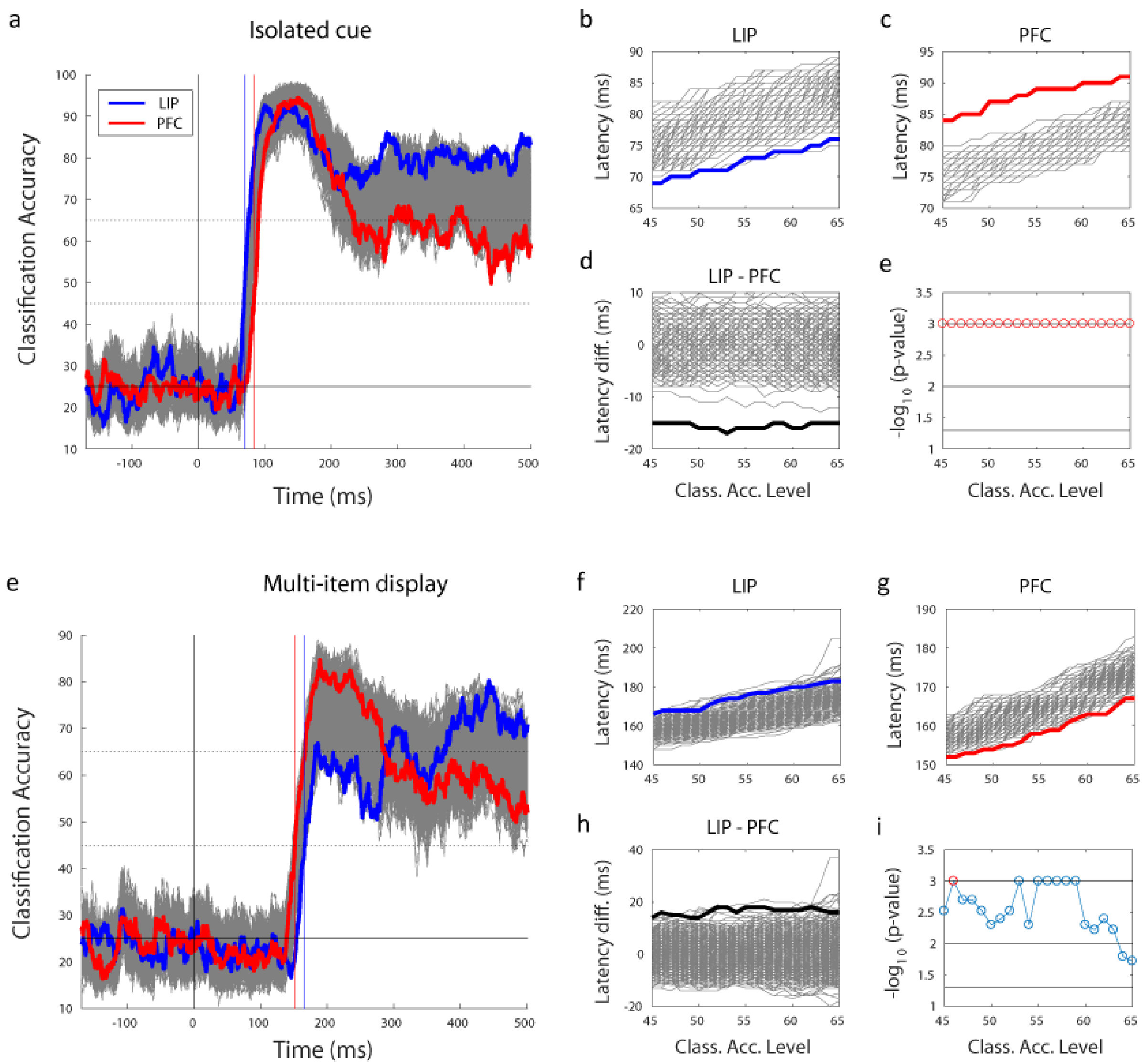
Supplemental Figures



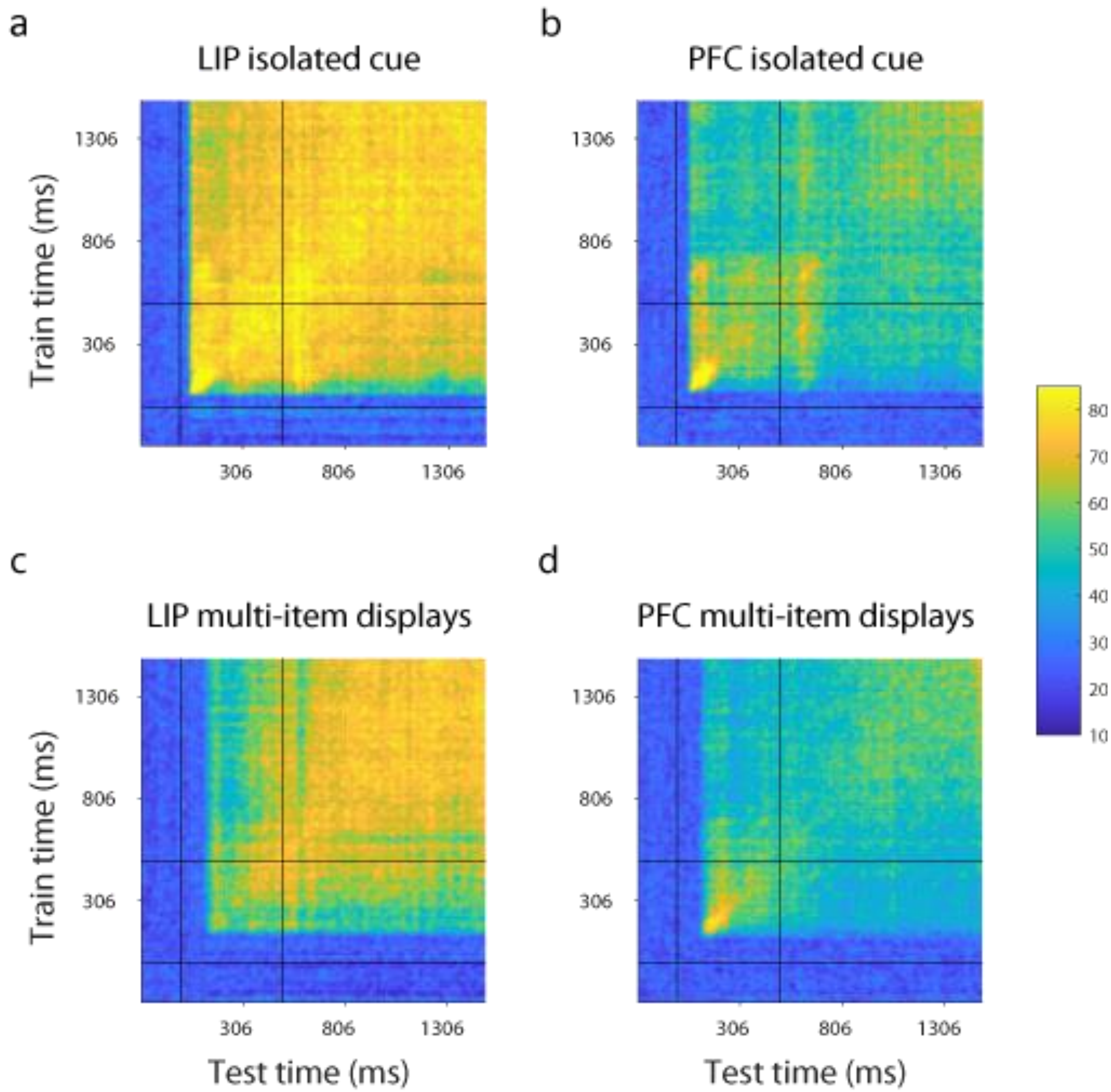
Supplemental Figure 1. Population firing rates first increase in LIP and then in PFC for both the isolated cue and clutter display trials. A comparison of the firing rates from PFC and LIP on the isolated cue trials (a) and on the cluttered display trials (b). For both types of displays, the firing rate increase (and peak) slightly earlier in LIP than in PFC. The same pattern was seen when the results were plotted separately for the red and green cues.



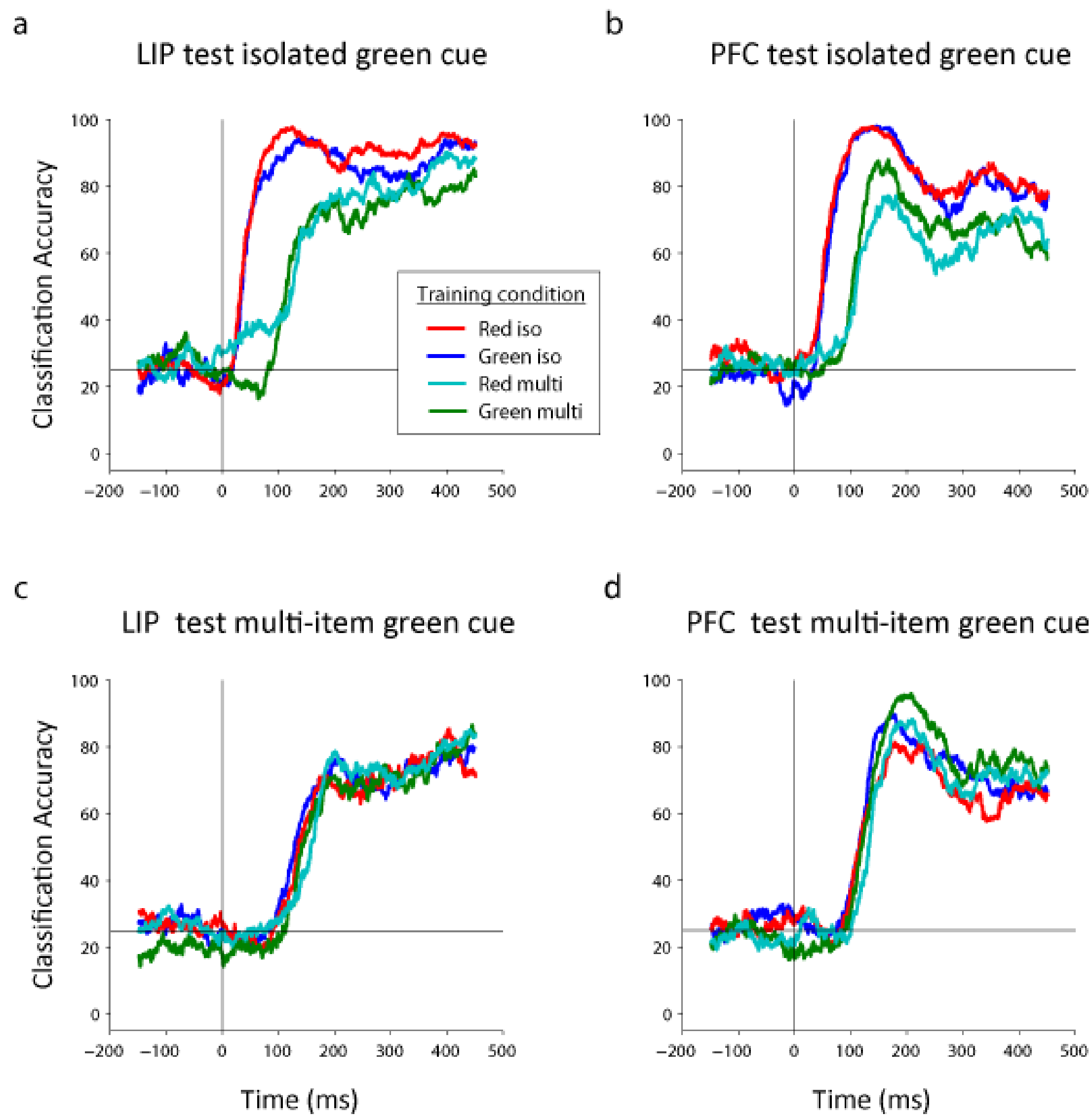
Supplemental figure 2. Comparison of decoded information about the cue location separately for the red and green cue trials. a, b) A comparison of the decoded from dlPFC (red) and LIP (blue) on the isolated cue trials when the cue was green (a) or when the cue was red (b). For both cue colors, information increases earlier in LIP than in PFC for the isolated cue displays. **c, d)** A comparison of the decoded from dlPFC and LIP on the multi-item cue trials when the cue was green (c) or when the cue was red (d). Here we see that for both cue colors, information increases early in PFC than in LIP for the multi-item displays. Solid bars at the bottom of the plots show when the decoding accuracies for LIP (blue) and PFC (red) are above chance (to save computational time when assessing when the results were above chance, we only ran 10 runs where the labels were shuffled and then collapsed the results across time to create a null distribution, which we found gives similar results as to creating a separate null distribution for each time bin). The results are based on using data in 100 ms bins sampled every millisecond.



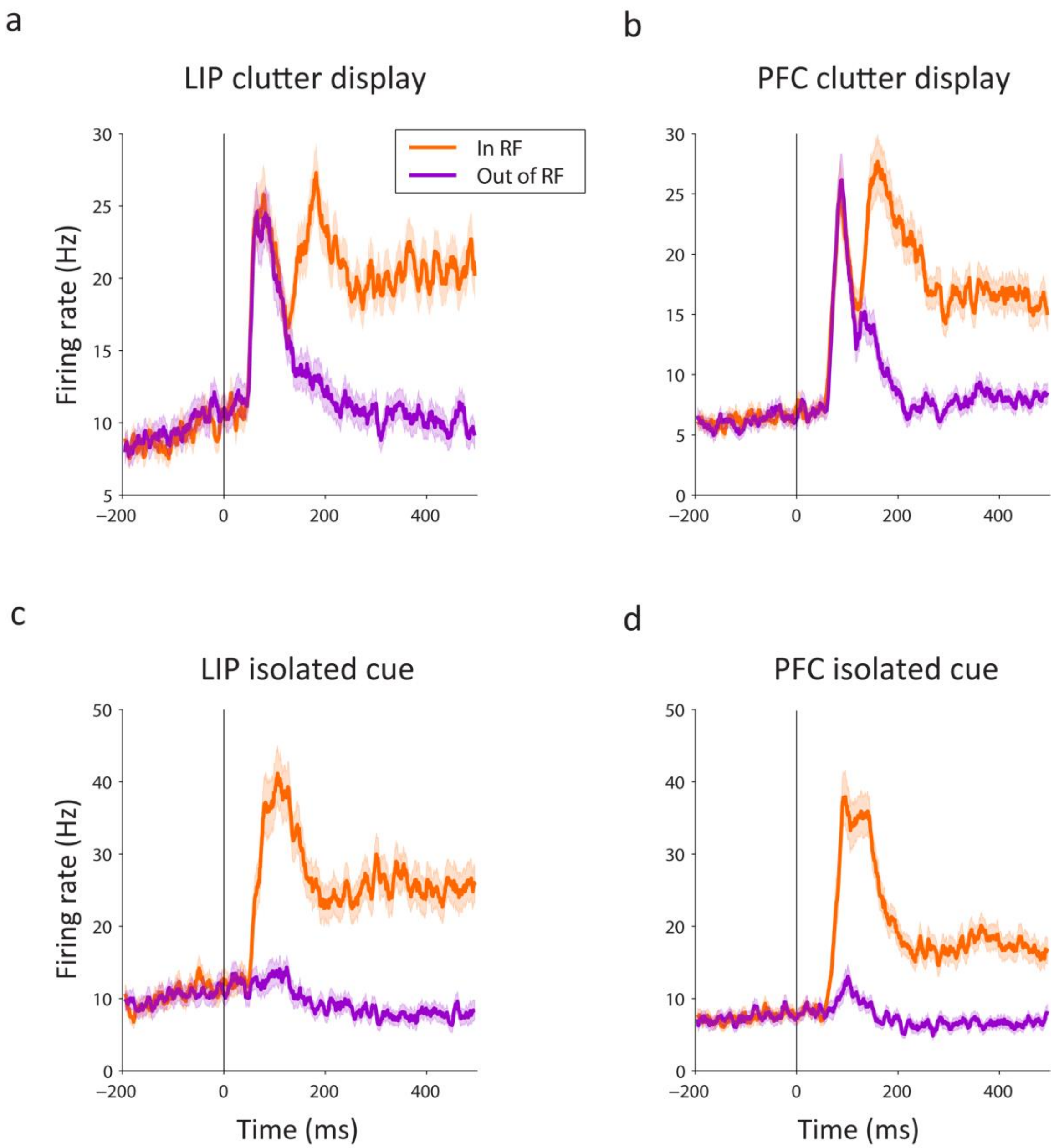
Supplemental figure 3. Assessing LIP and PFC latency differences by comparing them to combined LIP+PFC surrogate populations. **a, e)** Results showing LIP (blue) and PFC (red) decoding accuracies, compared to 1,000 surrogate decoding accuracies made from randomly sampling from the combined LIP and PFC data (gray lines), for the isolated cue (a-e), and multi-item displays (e-i). The dotted horizontal lines correspond to the classification accuracy thresholds range used in parts b-e and f-i. The red and blue horizontal lines show the latencies when LIP (blue) and PFC (red) first reach the 45% decoding accuracy threshold (i.e., the time where the red and blue lines cross the lower dotted line). **b, c, f, g)** Latencies of when the decoding results first reached a particular level of decoding accuracy for the surrogate populations (gray) and the real decoding results. The results show that the real LIP and PFC decoding accuracies have either earlier or later latencies than the combined surrogate population results. **d, h).** The difference between LIP and PFC real and surrogate result latencies. **e, i)** –log10(p-values) showing the percentage of the surrogate population latency differences that were larger than the actual latency differences. The black horizontal lines correspond to p-values of 0.001, 0.01, and 0.05. Red dots correspond to p-values less than < 0.001. For all decoding accuracy thresholds, the p-values are less than 0.05.



Supplemental Figure 4. Temporal-cross decoding plots extended over the first delay period. This is the same temporal-cross decoding analysis plot as figure 5 except that the analysis extends over the 1 second delay period. The results are based on 30 ms bins sampled at 10 ms intervals. The horizontal line are the training time of stimulus onset and offset, and the vertical lines are the test times of stimulus onset and offset. Overall he results appear to be relatively stationary over the delay period as well.



Supplemental figure 5. **Examining whether the spatial location decoding generalize across the color of the cue by testing with green cue trials. a, b)** Results from LIP (a) and from PFC (b) when ***testing*** *with isolated green cue data*. The color lines in the figure legend show the different conditions under which the classifier was ***trained***: 1) *red traces*: the classifier was trained isolated red cue trials 2) *blue traces*: the classifier was trained (on different) isolated green cue trials. The performance of the classifier trained on green cue trials was almost identical to the performance of a classifier trained on red cue trials showing spatial information is highly color invariant for the isolated cue trials. We also *trained* the classifier with multi-item trials: 3) *cyan traces*: training the classifier with multi-item red cue trials; 4) *green traces*: training the classifier with multi-item green cue trials (again all testing was done on the isolated green trials). Since information on the multi-item trials appears later, the results are shifted in time, however the classification accuracy was still highly insensitive to color, even when training for the location using a green cue among the red distractors. **c, d,** Results from LIP (c) and PFC (d) when ***testing*** *on data from green cue* ***multi-item*** *trials* and training on the all four cue/distractor combinations. Again the results are highly invariant to the color of the cue.



Supplemental figure 6. A Comparison of the average population firing rates when the cue stimulus was presented inside neurons' receptive fields versus outside of neurons' receptive fields. a, b) Average population firing rates from the multi-item display trials for LIP (a) and PFC (b), when the cue stimulus was in each neurons' receptive fields (orange trace) compared to when the cue stimulus was outside of neurons' receptive fields (purple trace). As can be seen, there are two peaks of firing rate increases when the cue is in the receptive field for both LIP and dlPFC. **c, d)** The same plots for the isolated cue trials for LIP (c) and dlPFC (d). For the isolated cue trials, only one peak is seen.