Supplemental Figures

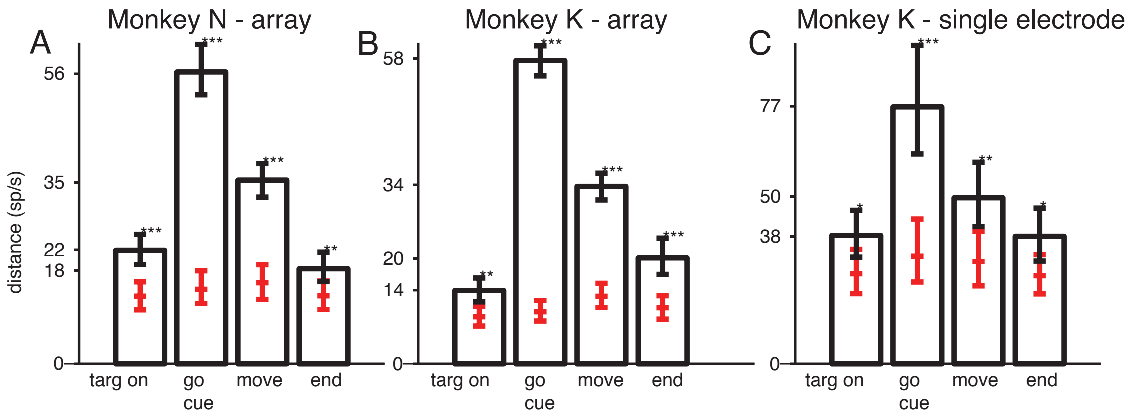

Figure S1; related to Figure 3
Distance metric performed without dimensionality reduction for pre-cued / non-pre cued task. (A) Monkey N. (B) Monkey K – array. (C) Monkey K – single electrode.

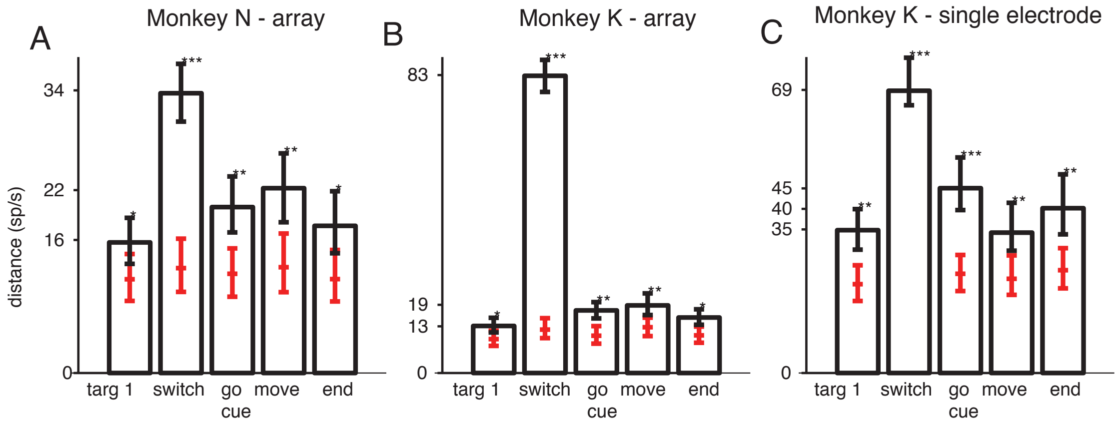

Figure S2; related to Figure 5
Distance metric performed without dimensionality reduction switch conditions followed by a second delay. (A) Monkey N. (B) Monkey K – array. (C) Monkey K – single electrode.

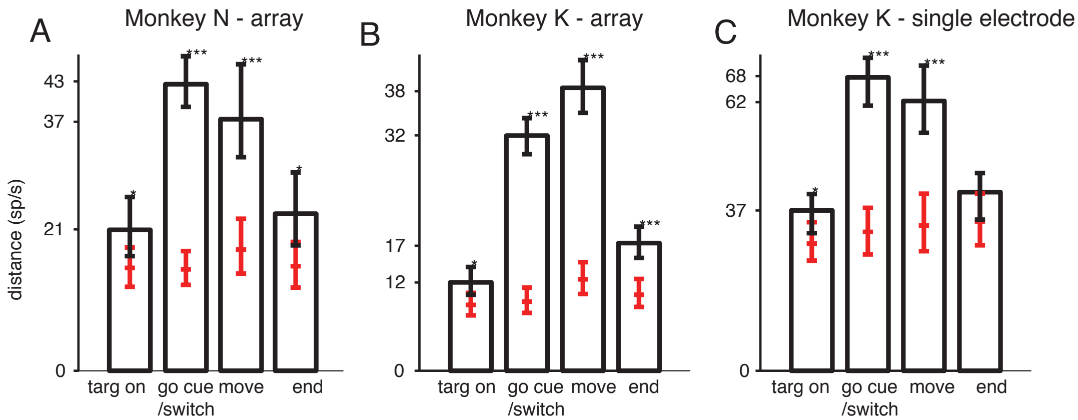

Figure S3; related to Figure 6
Distance metric performed without dimensionality reduction for switch conditions where the switch and go cue occurred simultaneously. (A) Monkey N. (B) Monkey K – array. (C) Monkey K – single electrode.

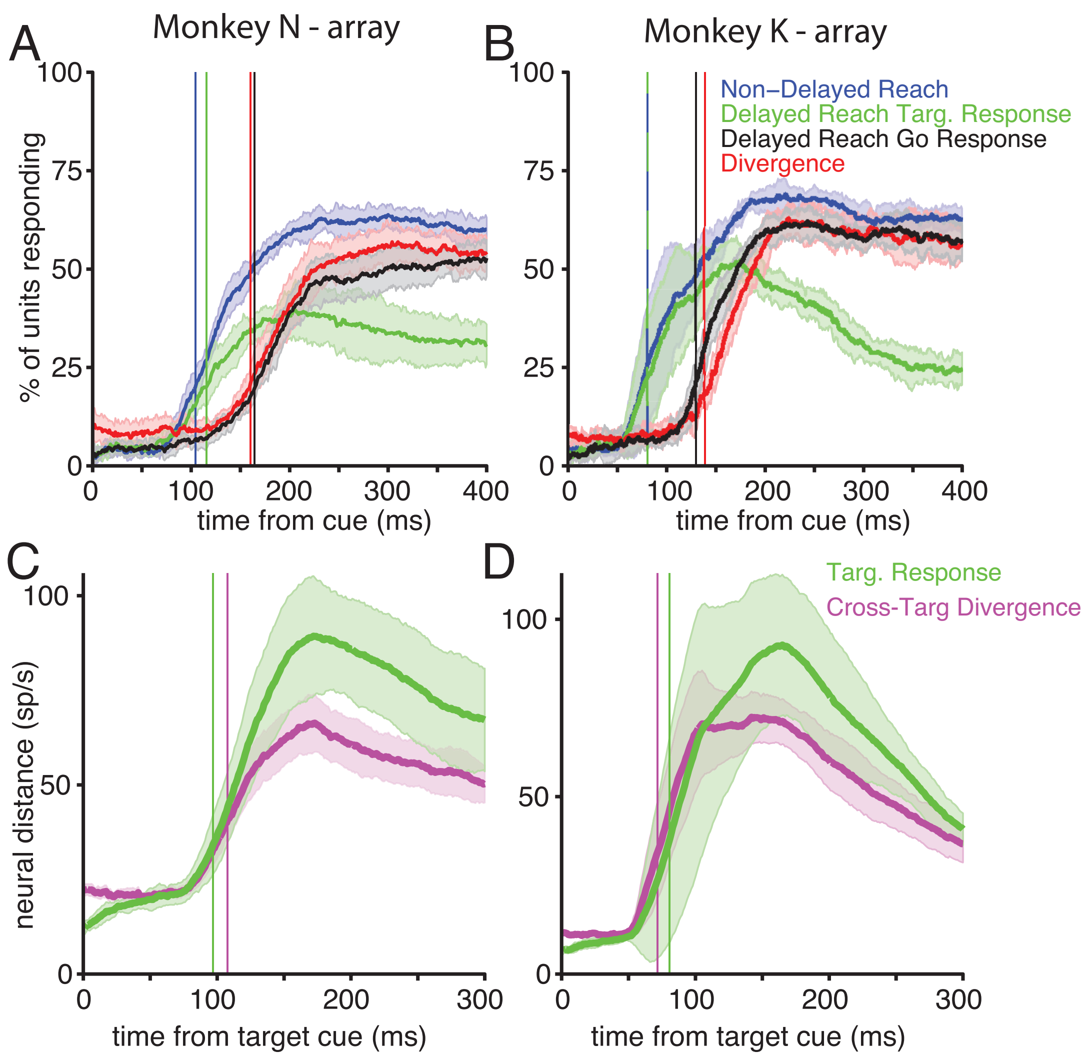

Figure S4; related to Figure 7

Relative timing of neural responses to external cues in delayed and non-delayed reach trials. (A-B) Percentage of neurons whose FR has changed significantly as a function of time from an external cue (mean +/- STD across reach directions). Vertical lines show the time that the percentage of responsive units crosses a 20% threshold (mean across reach directions). Green: % of neurons in delayed reaching conditions whose FR following target onset is significantly different from baseline. Blue: % of neurons in non-delayed reaching conditions whose FR following target onset is significantly different from baseline. Black: % of neurons in delayed reaching conditions whose FR following the go cue is significantly different from their FR during the delay. Red: % of neurons whose FR is significantly different between delayed and non-delayed reaches as a function of time from target onset. See also Figure S4. (C-D) Pink line, distance between delay-period neural trajectories for different targets, as a function of time from target onset (mean +/ STD). Green line: Distance between neural trajectories in delayed reaching conditions and baseline, as a function of time from target onset (mean +/- STD across reach directions). Neural trajectories for different targets begin diverging around the time that the trajectories begin responding to the target onset.

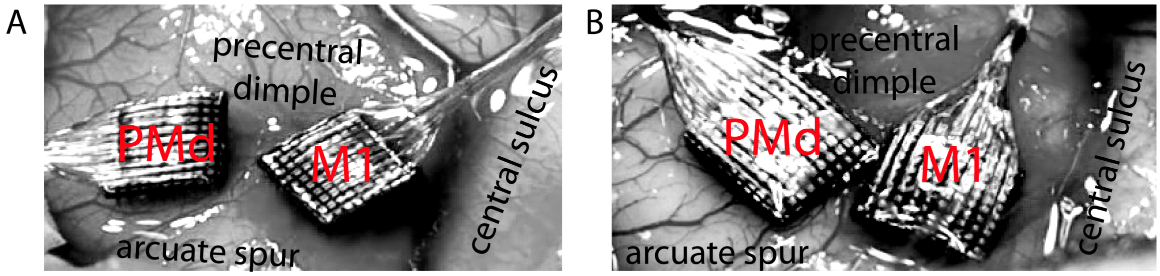

Figure S5
Array placement. (A) Placement of PMd and M1 arrays in Monkey N. (B) Placement of PMd and M1 arrays in Monkey K.

Monkey	Dataset	Dist at target onset (# signif)	Dist at go cue (# signif)	Dist at movement start (# signif)	Dist at movement end (# signif)
N	10/21/10	9.1 +/- 1.7 (6/8)	39.7 +/- 4.7 (8/8)	29.4 +/- 5.3 (8/8)	11.8 +/- 2.6 (8/8)
N	11/5/10	11.1 +/- 2.7 (4/8)	51.1 +/- 8.6 (8/8)	28.5 +/- 5 (8/8)	10.6 +/- 2.3 (4/8)
K	7/6/12	3.5 +/- 1.1 (1/7)	23.3 +/- 6 (7/7)	17 +/- 4.1 (7/7)	7.6 +/- 3.5 (6/7)
K	7/18/12	6.3 +/- 1.2 (0/7)	35.0 +/- 13.3 (7/7)	24.9 +/- 4.0 (7/7)	9.8 +/- 4.7 (2/7)
K	single electrode	15.4 +/- 2.9 (1/14)	27.3 +/- 7.6 (14/14)	20.8 +/- 5 (2/14)	20.3 +/- 4 (0/14)

Table S1, related to Figure 3

Mean +/- standard deviation distances across all reaches between delayed and non-delayed conditions, for all datasets examined. Distance measures are in spikes/s. Significance measured as p<.01 in resampling analysis.

Monkey	Dataset	Dist at target onset (# signif)	Dist at switch (# signif)	Dist at go cue (# signif)	Dist at movement start (# signif)	Dist at movement end (# signif)
N	2/4/11	6.7 +/- 0.9 (0/2)	31 +/- 5.9 (2/2)	10.6 +/- 2.0 (0/2)	9.2 +/- 0.9 (0/2)	9.3 +/- 1.7 (0/2)
N	3/11/11	4.3 +/- 0.6 (0/2)	39.6 +/- 3.5 (2/2)	13.8 +/- 0.9 (2/2)	11.1 +/- 5.6 (1/2)	5.4 +/- 0.5 (0/2)
K	7/10/12	7.1 +/- 2.2 (0/4)	54.4 +/- 6.6 (4/4)	13.8 +/- 1.7 (1/4)	9.4 +/- 2.7 (0/4)	8.8 +/- 1.3 (0/4)
K	7/19/12	5 +/- 1.5 (0/4)	53.7 +/- 19.0 (4/4)	9.5 +/- 2.2 (2/4)	7.1 +/- 0.6 (0/4)	5.5 +/- 1.3 (0/4)
K	single electrode	17.7 +/- 2.2 (0/4)	53.7 +/- 13.2 (4/4)	29.6 +/- 5.2 (0/4)	17.3 +/- 3.6 (0/4)	15.1 +/- 2.1 (0/4)

Table S2, related to Figure 5

Mean +/- standard deviation distances across all reaches between non-switch conditions and switches with a second delay, for all datasets examined. Distance measures are in spikes/s. Significance measured as $p<.01$ in resampling analysis.

Monkey	Dataset	Dist at target onset (# signif)	Dist at go cue (# signif)	Dist at movement start (# signif)	Dist at movement end (# signif)
N	2/4/11	8.8 +/- 1.4 (0/2)	46.3 +/- 2.5 (2/2)	26.7 +/- 3.5 (2/2)	13.7 +/- 3.3 (0/2)
N	3/11/11	10.8 +/- 5.5 (0/2)	31.5 +/- 3.7 (2/2)	31.9 +/- 15 (1/2)	11.7 +/- 3.8 (0/2)
K	7/10/12	6.4 +/- 1.4 (0/4)	23.6 +/- 7.2 (4/4)	18.5 +/- 2.4 (1/4)	7.1 +/- 1.0 (0/4)
K	7/19/12	4.6 +/- 0.9 (0/4)	29.4 +/- 9.0 (4/4)	21.8 +/- 2.3 (4/4)	6.5 +/- 1.1 (0/4)
K	single electrode	15.6 +/- 2.1 (0/4)	57.8 +/- 8.6 (4/4)	42.3 +/- 5.9 (2/4)	17.6 +/- 1 (0/4)

Table S3, related to Figure 6
Mean +/- standard deviation distances across all reaches between non-switch conditions and switches without a second delay, for all datasets examined. Distance measures are in spikes/s. Significance measured as $p<.01$ in resampling analysis.

Movie S1
Drawing the pre-cued and non-pre-cued neural trajectories shown in Figure 3D.

Movie S2
Drawing the delayed reach trajectory and trajectory of a target switch followed by a delay plotted in Figure 5C.

Movie S3
Drawing the delayed reach trajectory and trajectory of a target switch without a second delay plotted in Figure 6C.

Supplemental Experimental Procedures

Alternate Response Timing Analysis

Because distance analyses could be biased toward high-firing rate neurons, we wanted to use an alternate method to characterize the response timing of neurons which could take into account each neuron's individual firing rate distribution. We defined a neuron's FR at a given time as the number of spikes in a 40-ms bin preceding that time, as in the distance-based response timing analysis. To determine a given unit's response to a stimulus (e.g. turning on a rightward target) we first estimated the pre-stimulus FR distribution as the mean FR in the 10 ms preceding stimulus onset. After the stimulus, we then asked when the FR distribution across trials was significantly different (paired t-test, $p<.05$) from the pre-stimulus distribution. We considered all times up to 300 ms following the stimulus, yielding a 300-entry vector for each unit, where each entry was a 1 if the FR distribution was significantly different from before the stimulus, and a 0 otherwise. The average of all of these vectors across units gives the percentage of responsive units as a function of time from the stimulus. For each target, we looked at the percentage of responsive units across all units recorded, regardless of the units' tuning preferences.

To determine the divergence time between delayed and non-delayed reaches' response to the target, we performed a similar analysis. Instead of comparing the FRs for each unit to the pre-stimulus distribution, we instead compared the FR distributions from corresponding times in delayed and non-delayed reach trials. This yields a vector which represents whether, at each time, the FR distribution was significantly different between delayed and non-delayed reach trials. The mean of these vectors across all units represents the percentage of units with a different FR between delayed and non-delayed reaches as a function of time from target onset.

The results of this timing analysis agree with the distance-based response timing analysis, and are plotted in figure S4.

Across-target Response Timing Analysis

It is possible that the early neural response observed after target onset could reflect a general preparatory input, rather than a target-specific input. In this case, we would expect the initial target response to be the same regardless of which target appeared. To examine this possibility, we calculated the mean Euclidean distance between the target-response neural trajectory to one target and the target-response neural trajectories to each other target. We then asked when this distance crossed a threshold of 20 spikes/s greater than the distance at the time of target onset. We repeated this analysis for each target.

The distance across targets tends to increase at the same time that the neural trajectories begin changing (Figure S5 C-D). For both monkeys, the difference in cross-target divergence time and target response time was quite small (Monkey N: 11 +/- 6 ms; Monkey K: 9 +/- 12 ms different), and the responses to different targets diverged before the delayed/non-delayed trajectories diverged (Monkey N: 48 +/- 15 ms faster; Monkey

K: 74 +/- 13 ms faster). Our evidence therefore suggests that we do not have an initial, non-target-specific response which precedes target-specific information to the motor cortex.