

Supplementary Figure 1. Spiking Waveforms of All Units Tracked over the Entire CARP Experiment

(A) Waveform data shown here were taken from the Intuitive session, the last day of Perturbation session, and the last day of Washout session. Vertical axis represents electrode indices on the recording array, separately for Monkeys N and C. Red: perturbed neuron; Blue: unperturbed neuron; Gray: indirect neuron.

(B) Number of units tracked throughout each experiment. All supplementary figures are available at <https://doi.org/10.5281/zenodo.2438372>.

Supplementary Figure 2. Cursor Behavior during Catch Trials Mirrors that during Standard Trials for Monkey C.

(A) Cursor trajectories of the first 5 trials to each target on a particular day. Top row: standard trials with perturbation in place; bottom row: catch trials with Intuitive mapping. Colored circles represent the target locations. Solid curves and shaded areas indicate the mean and standard deviation of the trajectories to each target. Dotted circles represent halfway point where angular errors are assessed.

(B) Target acquisition time of catch trials across days. Each data point represents the mean of the first 480 trials on each day; the shaded area denotes standard error.

(C) Average cursor speed of catch trials across days. Note the speed of catch trials increases with training, suggesting that it is not an on-line correction for the visuomotor gain reduction of the CARP perturbation. Data is from the same trials used in (C).

Supplementary Figure 3. Directional Tuning Changes of Indirect Neurons Reflect Fast Component of Learning

(A and B) PD changes of the indirect neurons (gray) during learning for Monkey N and C, respectively. PD changes of the perturbed (red) and unperturbed (blue) groups of neurons are shown as reference. Plotting conventions are as in Figure 4B.

Supplementary Figure 4. Before- and After-Learning Tuning Curves of All Tracked Neurons for Monkey N

Tuning curves were shown in red for perturbed neurons, blue for unperturbed, and gray for indirect. Light and dark lines represent the average firing rate to each target before (Day 1) and after (Day 17) long-term practice, respectively. Error bars represent one SEM. Scale bars of firing rate are shown on the bottom left corner for each neuron. Each neuron's preferred direction before and after long term learning is shown with arrows and degree angles in the corresponding color.

35 **Supplementary Figure 5. Before- and After-Learning Tuning Curves of All Tracked Neurons for**
36 **Monkey C**
37 Same plotting format as Supplementary Figure 4. The tuning curves for each neuron were based on data
38 from Day 1 and Day 25 during the experiment for Monkey C.
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