

Supplementary Figure 1: *Influence of whisker deflection amplitude on the response modifications in backward pairing experiments.*

A. The response modification index for the unpaired whisker ( $\Delta R_{PW}$ ), the paired whisker ( $\Delta R_{AW}$ ) and the differential effect ( $\Delta R_{diff}$ ) is plotted against the delay ( $\Delta t$ ) of the pairing for L2/3 (circles) and L5-L6 (diamonds) cells with deflection amplitudes at activation threshold  $< 150 \mu m$ . The delay has been corrected to take into account the latency of the cortical response. Each pairing consisted in 400 action potential-deflection associations. In 16 % of the pairings 100 to 800 associations were applied. The histograms show the mean response modification indices ( $\pm$  SEM) for four different delay ranges. Responses to paired and unpaired whiskers were not significantly modified at any of the tested delay time windows. B. Scatter plots of the response modifications for the unpaired whisker ( $\Delta R_{PW}$ ), the paired whisker ( $\Delta R_{AW}$ ) and the differential effect ( $\Delta R_{diff}$ ) versus the amplitude of deflection used during pairing for short delay pairings ( $\Delta t < 17$  ms) of L2/3 (dots) and L5-L6 (diamonds) neurons. A significant linear regression was found for the paired whisker (middle) and the differential response (right), but not for the unpaired whisker.

Supplementary Figure 2: *Effects of PW pairing on responses to paired and unpaired whiskers in whole-cell STDP experiments.*

Average response modification indices (Top:  $\Delta PSPSlope$ ; bottom:  $\Delta PSPAmplitude$ ) for paired and unpaired whiskers. Each histogram bar shows the mean  $\Delta PSPSlope$  or  $\Delta PSPAmplitude$  for all pairings with the indicated range of  $\Delta t$ . Mean response indices that were significantly different from 0 (no plasticity) are indicated with asterisks. Only paired whiskers showed significant spike timing-dependent depression across the population; unpaired whiskers showed smaller, non-significant changes.