Time-course and mechanisms of homeostatic plasticity in layers 2/3 and 5 of the barrel cortex

Recent studies have shown that ocular dominance plasticity in layer 2/3 of the visual cortex exhibits a form of homeostatic plasticity that is related to synaptic scaling and depends on TNFα. In this study, we tested whether a similar form of plasticity was present in layer 2/3 of the barrel cortex and, therefore, whether the mechanism was likely to be a general property of cortical neurons. We found that whisker deprivation could induce homeostatic plasticity in layer 2/3 of barrel cortex, but not in a mouse strain lacking synaptic scaling. The time-course of homeostatic plasticity in layer 2/3 was similar to that of L5 regular spiking (RS) neurons (L5RS), but slower than that of L5 intrinsic bursting (IB) neurons (L5IB). In layer 5, the strength of evoked whisker responses and ex vivo miniature excitatory post-synaptic currents (mEPSCs) amplitudes showed an identical time-course for homeostatic plasticity, implying that plasticity at excitatory synapses contacting layer 5 neurons is sufficient to explain the changes in evoked responses. Spontaneous firing rate also showed homeostatic behaviour for L5IB cells, but was absent for L5RS cells over the time-course studied. Spontaneous firing rate homeostasis was found to be independent of evoked response homeostasis suggesting that the two depend on different mechanisms.