## **Supporting Information**

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**Fig. S1.** B-type botulinum toxin (BOTOX) loading blocked the ACh-induced LTP of excitatory synapses in CA1 PCs. (*A*) AMPA receptor-mediated excitatory postsynaptic currents (EPSCs) isolated under 50  $\mu$ M picrotoxin (PiTX) recorded at -75 mV (downward deflections preceded by current induced by a brief hyperpolarizing pulse) with intracellular BOTOX (0.5  $\mu$ M in the pipette). EPSCs were briefly depressed following an ACh pulse and later recovered control amplitudes. (*B*) (*Left*) Average control EPSCs (*n* = 10). (*Center*) Transient depression following ACh. (*Right*) Recovery of EPSC amplitude to control values 50 min after the ACh pulse. Data in *B* are taken from *A*. (*C*) Same as *B*, showing AMPA component at -75 mV (solid circles) and of the NMDA component at 60 mV and 50-ms delay (open circles).



**Fig. S2.** The long-term enhancement of  $\gamma$ -aminobutyric acid type A inhibition (GABA<sub>A</sub>-LTP) was larger at 0 mV than at -75 mV and was unaffected by the Cl<sup>-</sup> driving force, the Cl<sup>-</sup> concentration gradient, and K<sup>+</sup> conductance block. (A) Plot of the average peak inhibitory postsynaptic potential amplitude vs. time, showing the GABA<sub>A</sub>-LTP recorded at the 0-mV steps with the 10-mM Cl<sup>-</sup> intracellular solution. The upper values are inhibitory postsynaptic current (IPSC) averages from a representative experiment at time points 1, 2 and 3. (B) Same as A [same pyramidal cells (PCs)], but recorded at -75 mV. Note the stronger potentiation at 0 mV than at -75mV. (C) Same as A and B (different PCs), but showing the GABA<sub>A</sub>-LTP recorded at 0 mV with the 110-mM Cl<sup>-</sup> cs<sup>+</sup>-based intracellular solution. The upper values are IPSC averages from a representative experiment at time points 1, 2 and 3. (D) Pooled data taken from experiments as in A-C, showing the potentiation reached 60 min after acetylcholine (post-Ach) with the 10-mM Cl<sup>-</sup> solution at 0 mV and -75 mV (N = 6, same cells), and with the 110-mM CsCl<sup>-</sup> solution at -75 mV (N = 7). Data are expressed as the percentage change from baseline (100%, dotted lines) for each respective condition.



**Fig. S3.** Effects of the timing and duration of the stimulation protocol and contribution of CCK<sup>+</sup> and PV<sup>+</sup> IPSCs to GABA<sup>A</sup>-LTP. (*A*) The peak average IPSC amplitude plotted against time, showing the GABA<sub>A</sub>-LTP developed following a late interruption of the depolarizing pulse protocol (no Dep., horizontal shaded bar). (*B*) Same as *A* but with an interruption of synaptic stimulation (no IPSC, horizontal shaded bar). (*C*) Plot of the IPSC amplitude against time, showing the transient potentiation induced when the 30-s/75-s pulse protocol (shown at top) was interrupted 10 min after the ACh pulse. A single 30-s step to 0 mV applied ~18 min later had no effect on the IPSC amplitude. (*D*) Plot of the IPSC amplitude against time, showing that  $\omega$ -conotoxin GVIA ( $\omega$ -CgTx) (250 nM, horizontal shaded bar) also reduced GABA<sub>A</sub>-LTP strongly reduced the IPSC amplitudes. (*E*) Same as *A*, showing that  $\omega$ -agatoxin ( $\omega$ -Aga) (1  $\mu$ M, horizontal shaded bar) also reduced GABA<sub>A</sub>-LTP. In *D* and *E*, the baseline (100%) was computed as the average IPSC peak amplitude reached post-ACh when the GABA<sub>A</sub>-LTP ture.