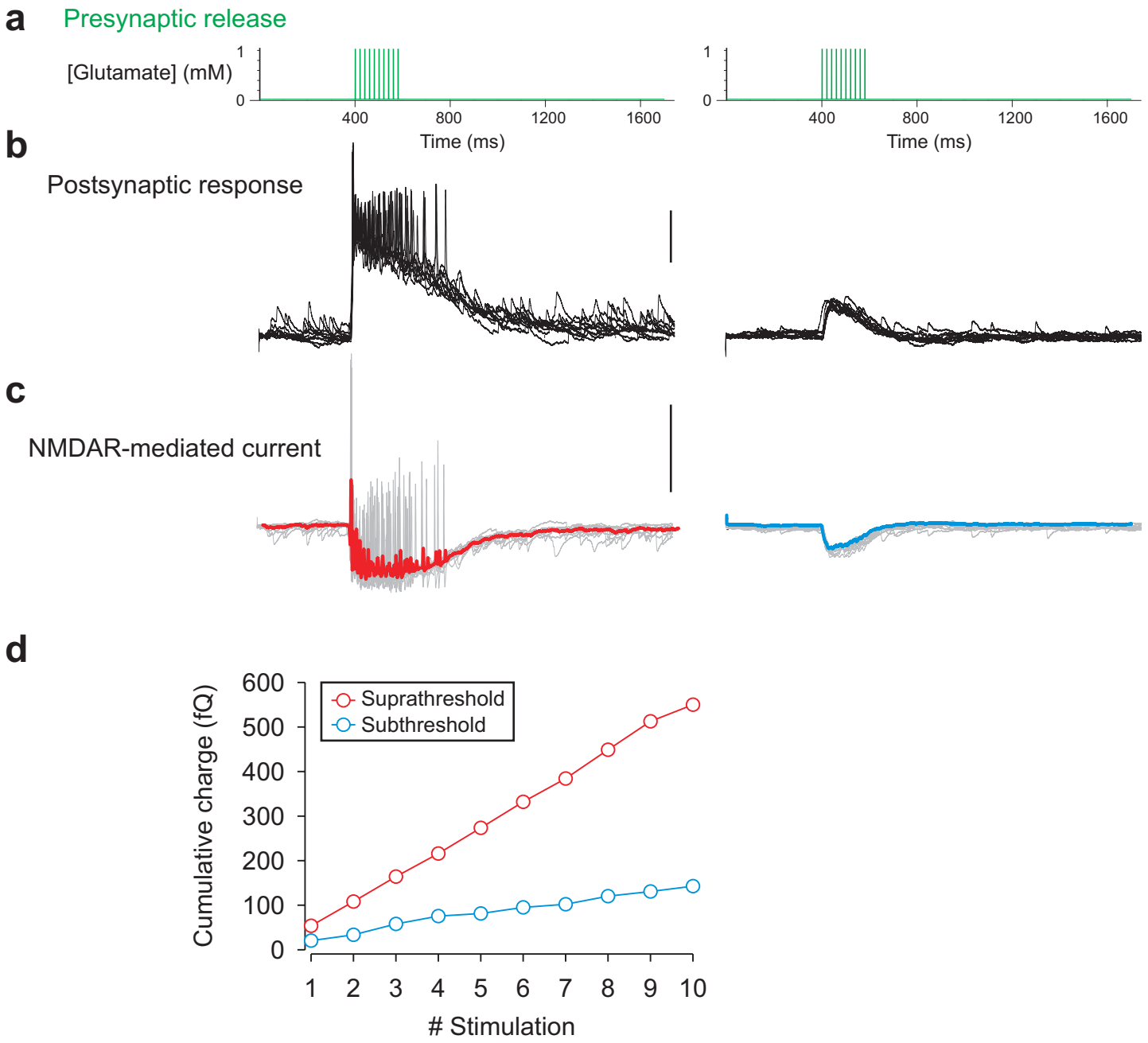
Supplementary Figure 1
Lien et al., 2006

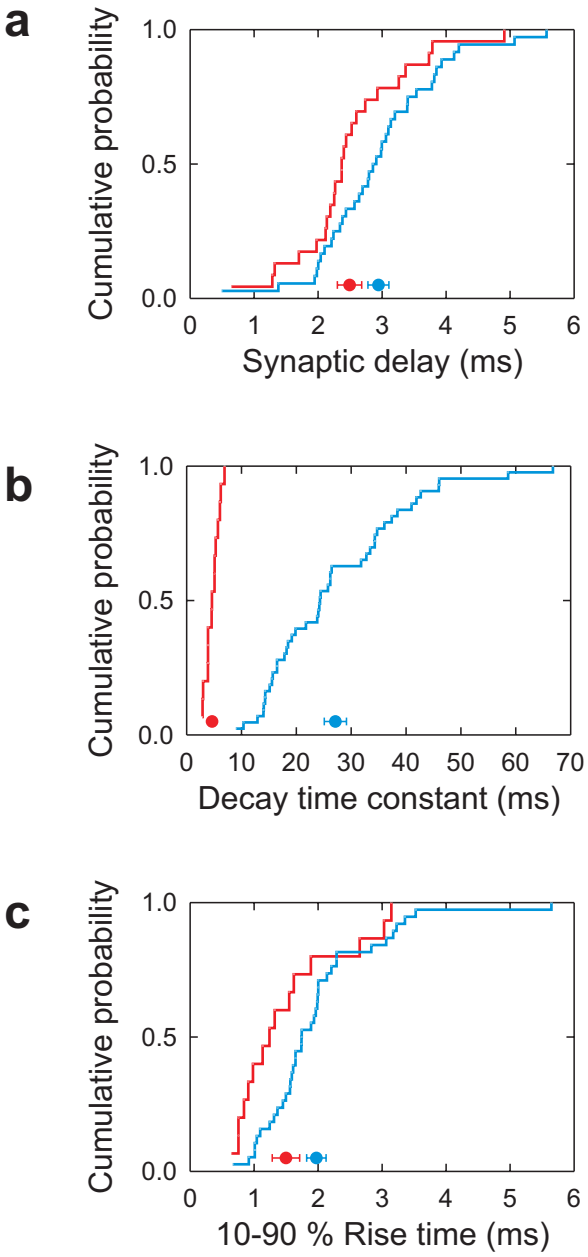


Supplementary Fig. 1 Legend

Simulated NMDAR-mediated currents associated with bursting spikes and subthreshold responses.

(**a**) We assume that the light stimulus induces the release of glutamate by triggering presynaptic bursts (10 pulses with 1-ms duration at 100 Hz), resulting in brief changes of glutamate concentration from 25 μM to 1 mM in the synaptic cleft. (**b**) The measured supra- and subthreshold membrane depolarization associated with the “off-response” of the cells shown **Fig. 1b**. (**c**) Ten consecutive traces of simulated NMDAR-mediated currents triggered by glutamate (shown in **a**) during supra- and subthreshold depolarizations are superimposed, respectively. The red and blue curves are averaged traces. (**d**) Cumulative charges of NMDAR-mediated currents, activated during supra- and subthreshold depolarization associated with the off-responses triggered by 10 repeated light stimuli. Scales: 20 mV, 0.4 pA.

Supplementary Figure 2
Lien et al., 2006

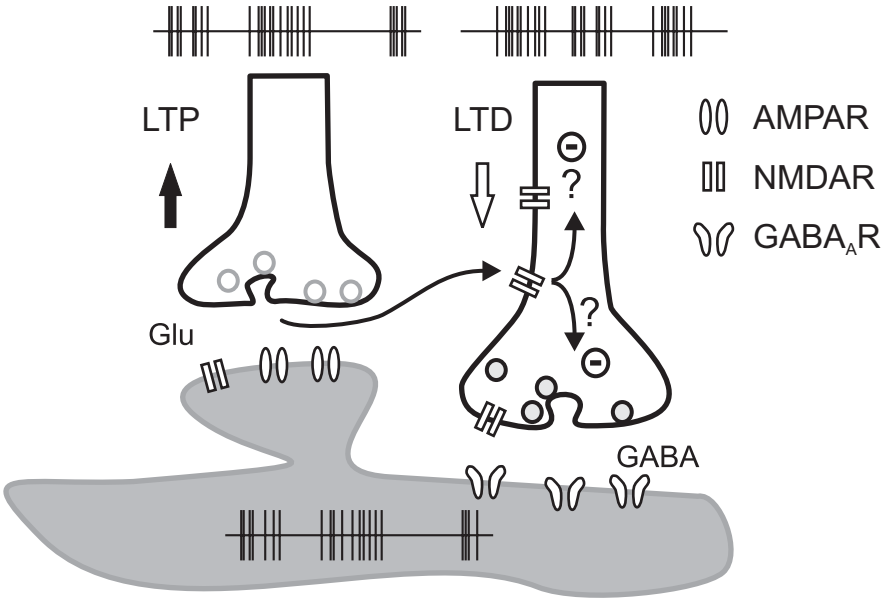


Supplementary Fig. 2 Legend

Synaptic delay, decay time, and rise time of EPSCs and IPSCs.

(**a**) Cumulative plot of the synaptic delay of EPSCs and IPSCs (2.5 ± 0.2 versus 3.0 ± 0.2 ms, $P = 0.08$, $n = 23$ and 36, respectively). (**b**) Cumulative plot of the decay time constant of EPSCs and IPSCs (4.6 ± 0.3 versus 27.1 ± 2.0 ms, $P < 0.0005$, $n = 15$ and 43, respectively). (**c**) Cumulative plot of the 10 - 90% rise time of EPSCs and IPSCs (1.5 ± 0.2 and 2.0 ± 0.2 ms, $P = 0.09$, $n = 15$ and 38, respectively). Significance was tested by the two-sided t-test.

Supplementary Figure 3
Lien et al., 2006



Supplementary Fig. 3 Legend

Coincident NMDAR activation and presynaptic activity are required for GABAergic LTD.

A proposed model for coordinated modification of associative homosynaptic LTP at glutamatergic synapses and heterosynaptic LTD at GABAergic synapses. Spillover of glutamate from excitatory synapses activates presynaptic NMDARs of GABAergic synapses, leading to LTD of GABAergic synapses when the latter is co-activated at a high-frequency.

Supplementary Method

The extent of NMDARs activation (**Supplementary Fig. 1**) during spiking or non-spiking depolarizations of off-response of tectal neurons (from the same cell shown in **Fig. 1b**) was simulated using the asymmetric trapping block model (ref. 16). The pattern of presynaptic glutamate release was approximated by using experimentally recorded spike trains from retinal ganglion cells in response to light stimuli (ref. 17). We assumed that each spike-triggered glutamate release leads to an increase in the glutamate concentration from basal level of 25 μM to 1 mM for 1-ms duration (**Supplementary Fig. 1a**). The model used for simulating NMDAR currents consisted of 20 NMDARs (single channel conductance is 50 pS, with extracellular 1.5 mM Mg^{2+}) on the postsynaptic neuron (without considering the neuronal morphology). The simulation results showed a much larger extent of NMDAR activation by spiking waveforms than that by non-spiking ones. The change in the total charge relative to the baseline was quantified by integrating the NMDA-mediated currents from 360 to 1200 ms (see **Supplementary Fig. 1c**,**d**). In summary, the total charge estimated was at least 5-fold larger in spiking forms than that in non-spiking forms (**Supplementary Fig. 1d**).