Supplementary Materials

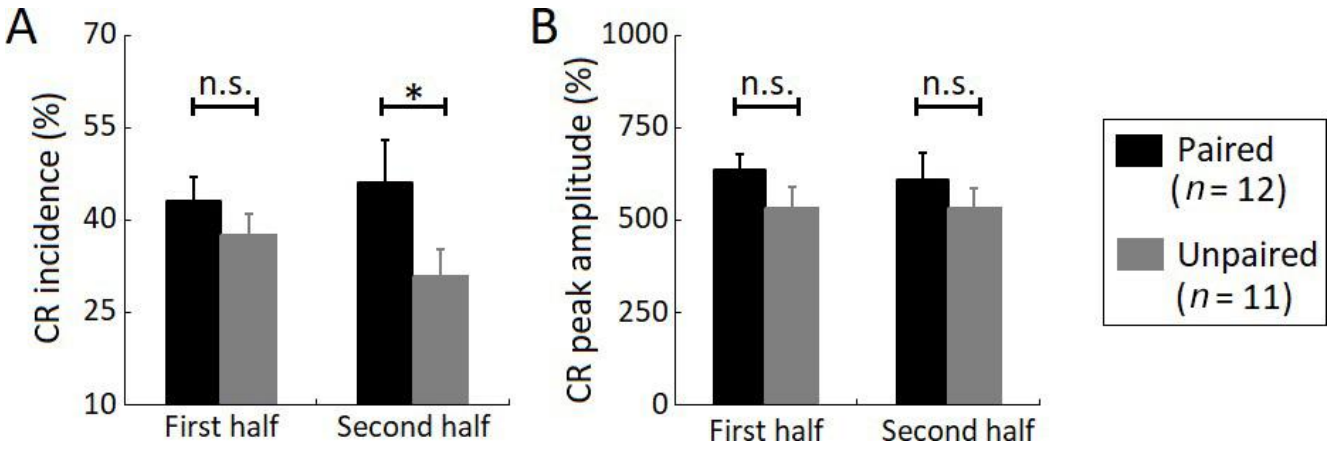

Fig. S1 CR acquisition on day 1. **A** CR incidence measured from the mice with paired (n = 12, black) and unpaired (n = 11, grey) training on day 1. There is no significant difference during the first half (trials 1–50) (paired group, 43.4% ± 3.8% *vs* unpaired group, 37.6% ± 3.6%, t_{21} = 1.169, P = 0.255, independent t test). By contrast, there is a significant difference during the second half (trials 51–100) (paired group, 46.4% ± 6.8% *vs* unpaired group, 30.9% ± 4.5%, t_{21} = 2.174, P = 0.045, independent t test). **B** CR peak amplitude measured from the mice with paired (n = 12, black) and unpaired (n = 11, grey) training. There is no significant difference between the paired and unpaired groups during either the first or the second half of training (First half: paired group, 638.9% ± 42.4% *vs*. unpaired group, 532.5% ± 60.9%, t_{21} = 1.579, P = 0.130; Second half: paired, 612.3% ± 71.3% *vs* unpaired, 535.9% ± 52.7%, t_{21} = 0.902, P = 0.377, independent t tests). Data are expressed as the mean ± SEM (*P <0.05, n.s., not significant).

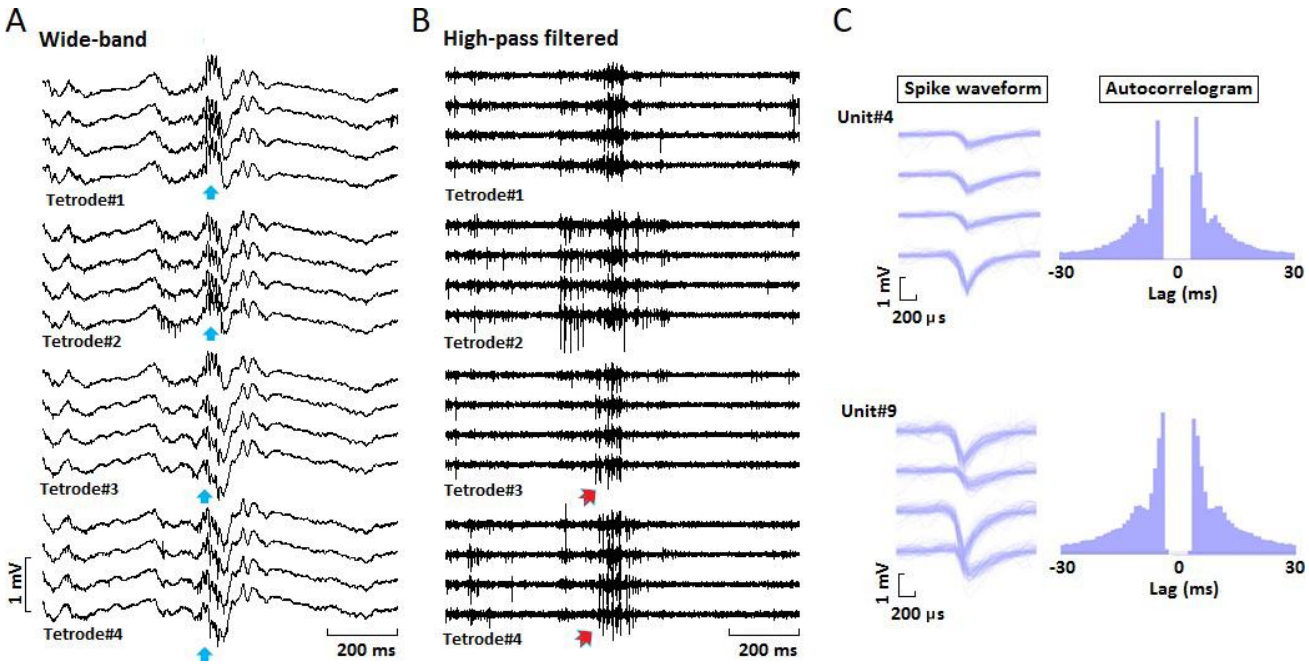

Fig. S2 *In vivo* identification of electrophysiological recording in dorsal hippocampus. **A** Example wide-band tetrode recording from the dorsal hippocampus (blue arrows, sharp wave-ripple (SWR) events). **B** High-pass (100–250 Hz) filtered traces from **A**, showing the activation of a cell assembly during SWR events (red arrows, hippocampal spikes associated with the occurrence of SWRs). **C** Spike waveforms and autocorrelograms for two representative units（unit #4 and #9）recorded from tetrodes #3 and #4.

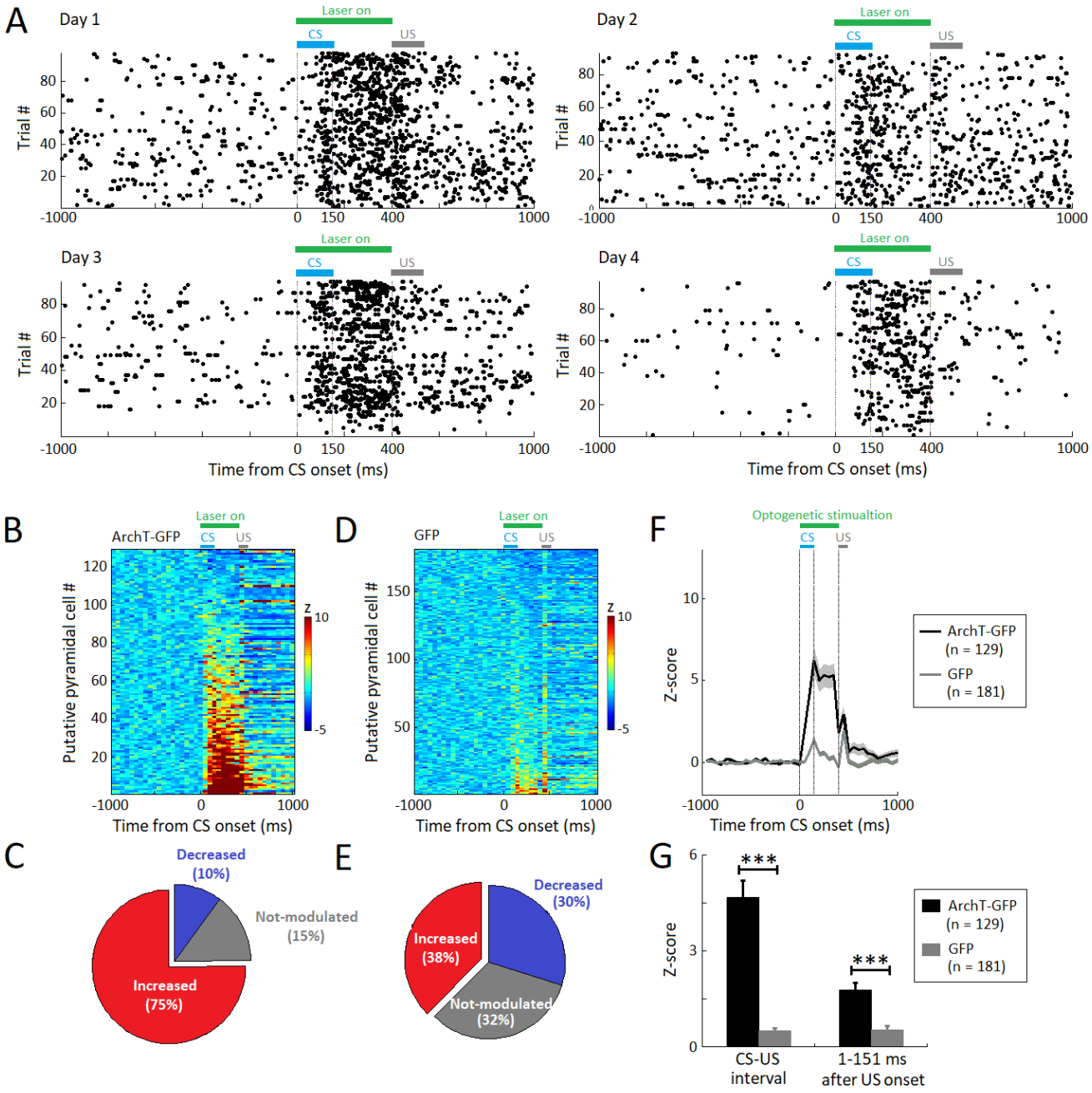

Fig. S3 Effect of optogenetic stimulation on the firing activity of putative pyramidal cells (Pyrs) during tEBC training. **A** Representative spike raster showing the effect of optogenetic stimulation on the firing activity of Pyrs during tEBC from day 1 to day 4. **B** Pseudocoloured, baseline normalized peri-CS histograms of all classified Pyrs (*n* = 129) during the acquisition of tEBC in mice expressing ArchT. Delivery of green laser light in the CS–US period was trigged by CS onsets. **C** Proportions of Pyrs showing increased (75%), decreased (10%), or minimal responses (15%) to optogenetic

stimulation in mice expressing ArchT. **D** Pseudocoloured, baseline normalized peri-CS histograms of all classified Pyrs (n = 181) during the acquisition of tEBC in mice expressing GFP. Delivery of green laser light in the CS–US period was trigged by CS onsets. **E** Proportions of Pyrs showing increased (38%), decreased (30%), or minimal responses (32%) to the CSs in mice expressing GFP. **F** Average Z scores of Pyr firing activity in mice expressing ArchT and GFP. **G** Left, Pyr firing activity during the CS-US period in mice expressing ArchT is greater than that in mice expressing GFP (ArchT-GFP: n = 129 units, GFP: n = 181 units, t_{308} = 9.5435, $P = 4.4413 \times 10^{-19}$, independent t test); right: Pyr firing activity during the 1–150 ms period after the US onset in mice expressing ArchT is greater than that in mice expressing GFP (t_{308} = 5.2654, $P = 2.6296 \times 10^{-7}$, independent t test). Therefore, the change of US-evoked activity is unlikely to be related to the CR impairment after optogenetic suppression. Data are expressed as the mean ± SEM (***P <0.001).