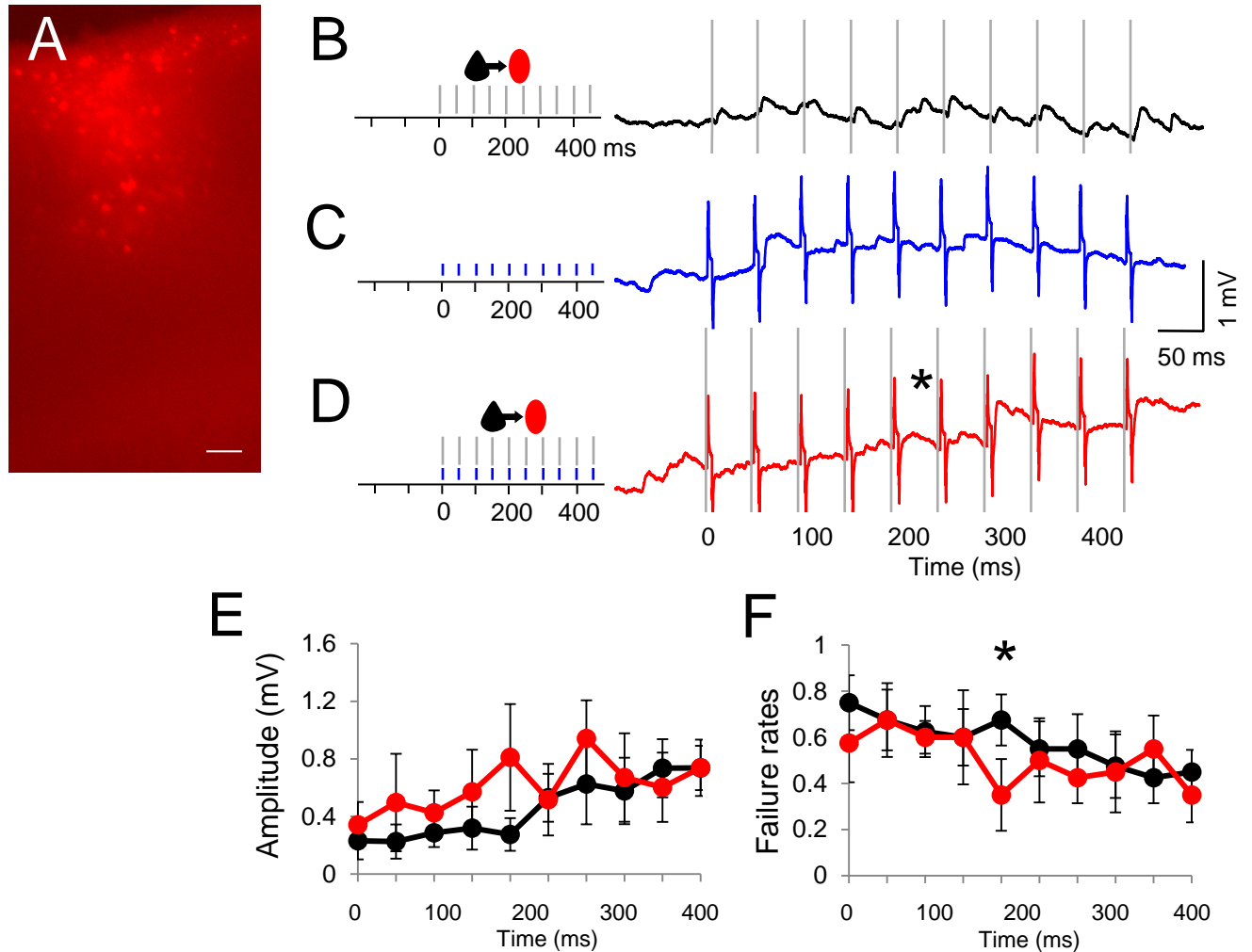
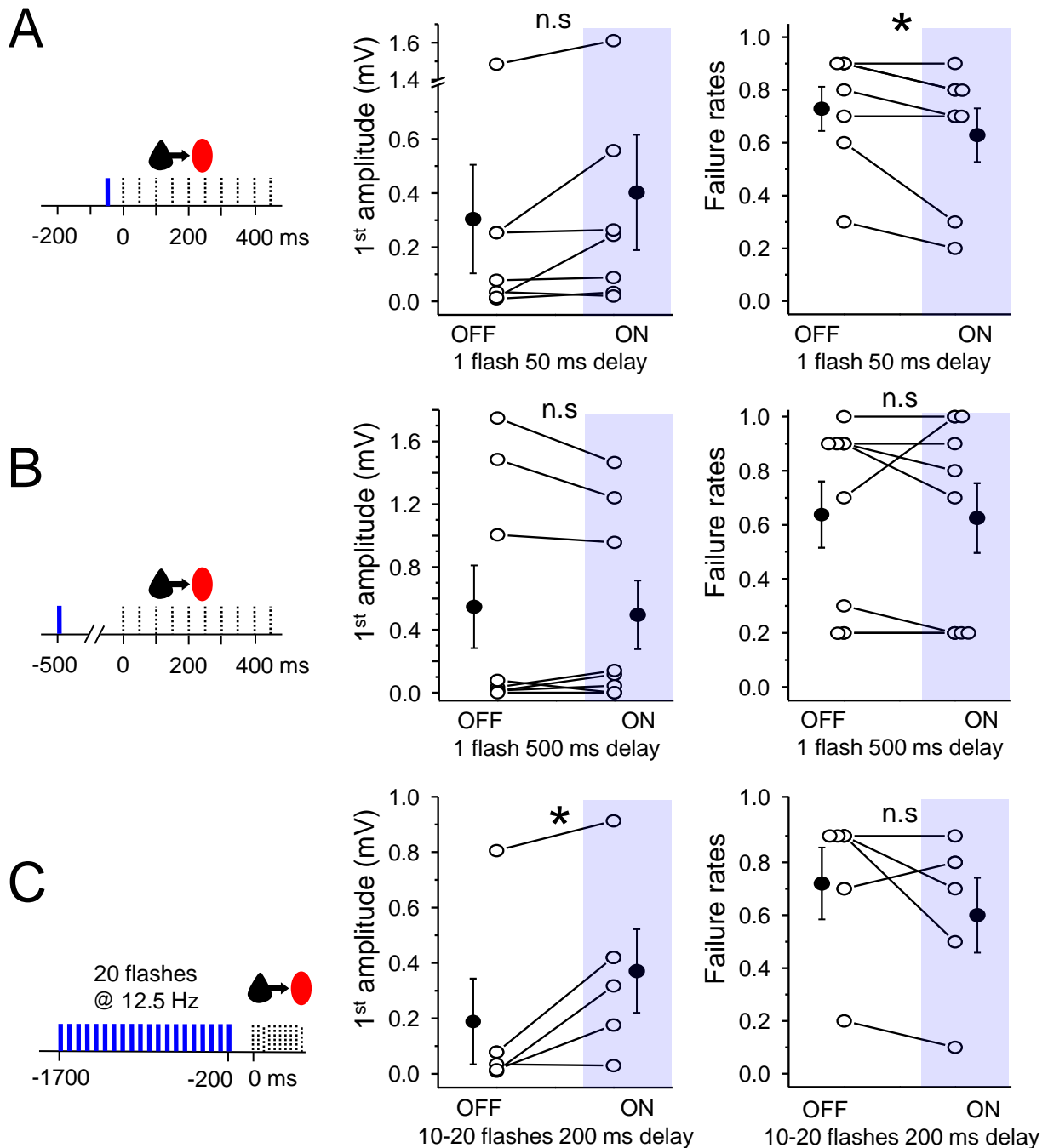


Supplemental Figure 1 (related to Figure 4)



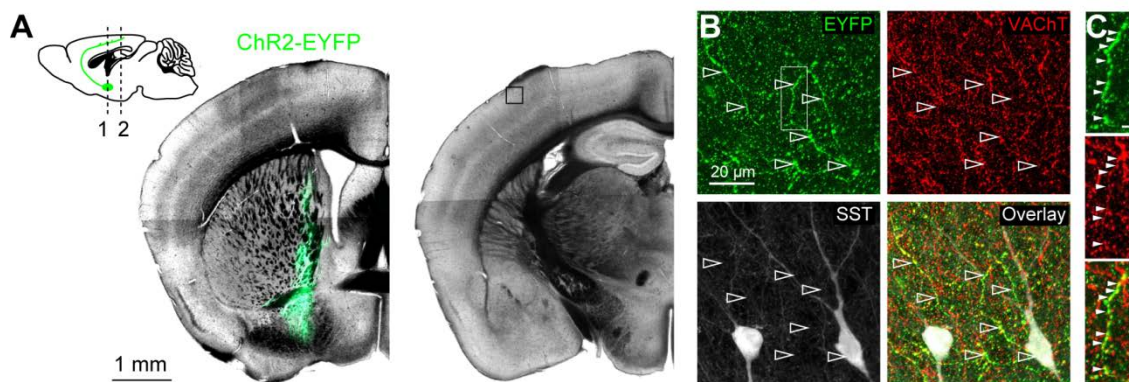
Supplemental Figure 1 related to Figure 4. Endogenous acetylcholine release enhances Pyr-SST synapses at a 200 ms delay. (A) A picture of a slice showing SST-Tdt neurons. Scale bar 50 μm (A-C) Left schematics show experimental procedures. Blue bars indicate blue light cholinergic fibers opto-stimulation. Dotted gray bars show spikes in pyramidal neurons. Right traces show the averaged trace of 10 response trials in SST neurons. (A) EPSP in Pyr-SST connection under baseline condition/light OFF. (B) SST membrane response after 10 blue flashes. (C) EPSP in Pyr-SST connection under simultaneous pyramidal neuron stimulation and cholinergic fibers opto-activation. (D) Mean EPSP amplitude in response to all 10 spikes in the train, for light OFF and ON conditions. (E) The same as in (D) but for mean failure rates. The plots represents mean and SEM.

Supplemental Figure 2 (related to Figure 4)



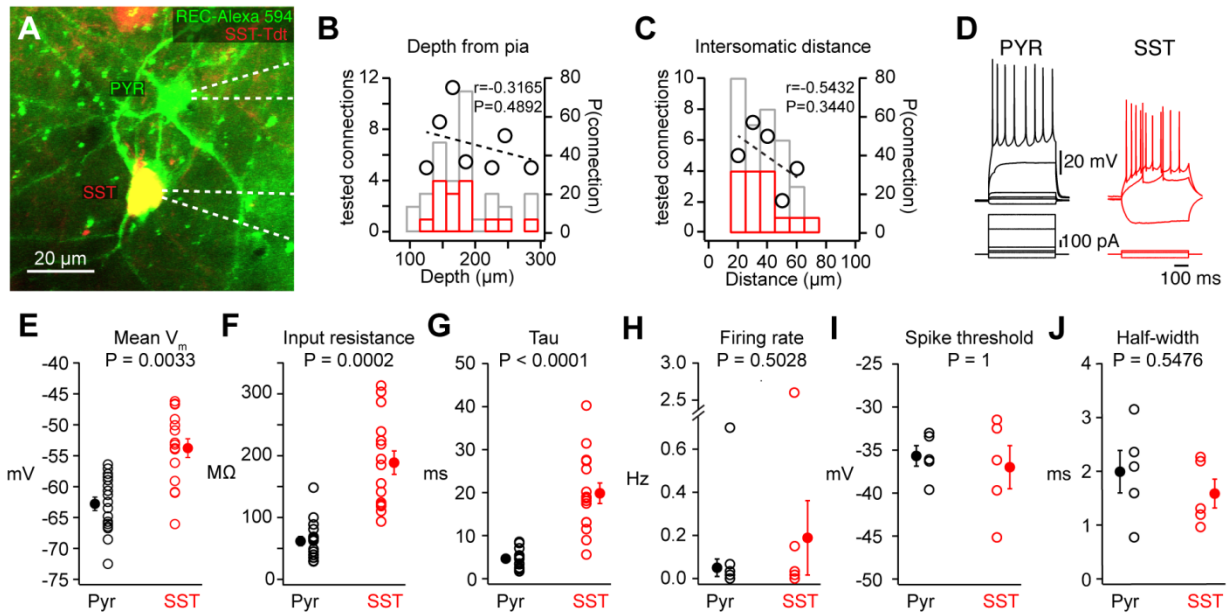
Supplemental Figure 2 related to Figure 4. Effects of different patterns of cholinergic fibers photo-stimulations on Pyr-SST synapse efficacy. (A-C) Left schematics show experimental procedures. **(A)** Mean EPSP amplitude and failure rates for baseline condition (OFF) and after 1-single blue light flash (10 ms) delivered 50 ms prior to the presynaptic spike train (ON). **(B)** The same as for (A) but for 1-single blue light flash (10 ms) delivered 500 ms prior to the presynaptic spike train. **(C)** The same as for (A) but for 20 blue light flashes (10 ms) delivered at 12.5 Hz frequency and the presynaptic spike train delivered 200 ms after the last blue light flash. The bar graphs represent mean and SEM.

Supplemental Figure 3 (related to Figure 6)



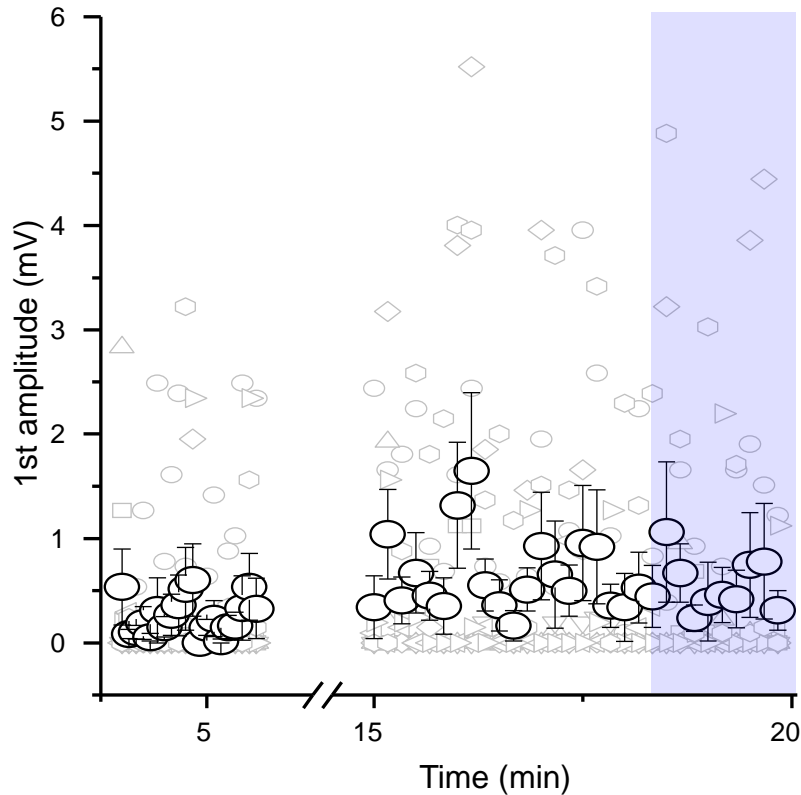
Supplemental Figure 3 related to Figure 6. Characterization of nucleus basalis viral infection in SST.crexAi9 mice. (A) inset showing the location of the coronal slices. Left: coronal slice showing the site of infection which correlates with the location of the nucleus basalis (Bregma: 0.02 mm, lat: 1.3 mm, depth: 4.5 mm). Right: coronal slice of the same brain. Black square represents the location of the imaging field of view in the somatosensory cortex shown in panel (B) and (C). (B) Colocalization (white arrow heads) of nucleus basalis ChR2-EYFP expressing fibers (green) with the immunostaining of the vesicular Ach transporter (VACHT, red). Note: colocalisation puncta can be found close to dendrites and cell somata of SST neurons (white). (C) zoom showing colocalisation of VACHT signal (red) with nucleus basalis ChR2-EYFP expressing fibers (green). Scale bar: 5 μm.

Supplemental Figure 4 (related to Figure 6)



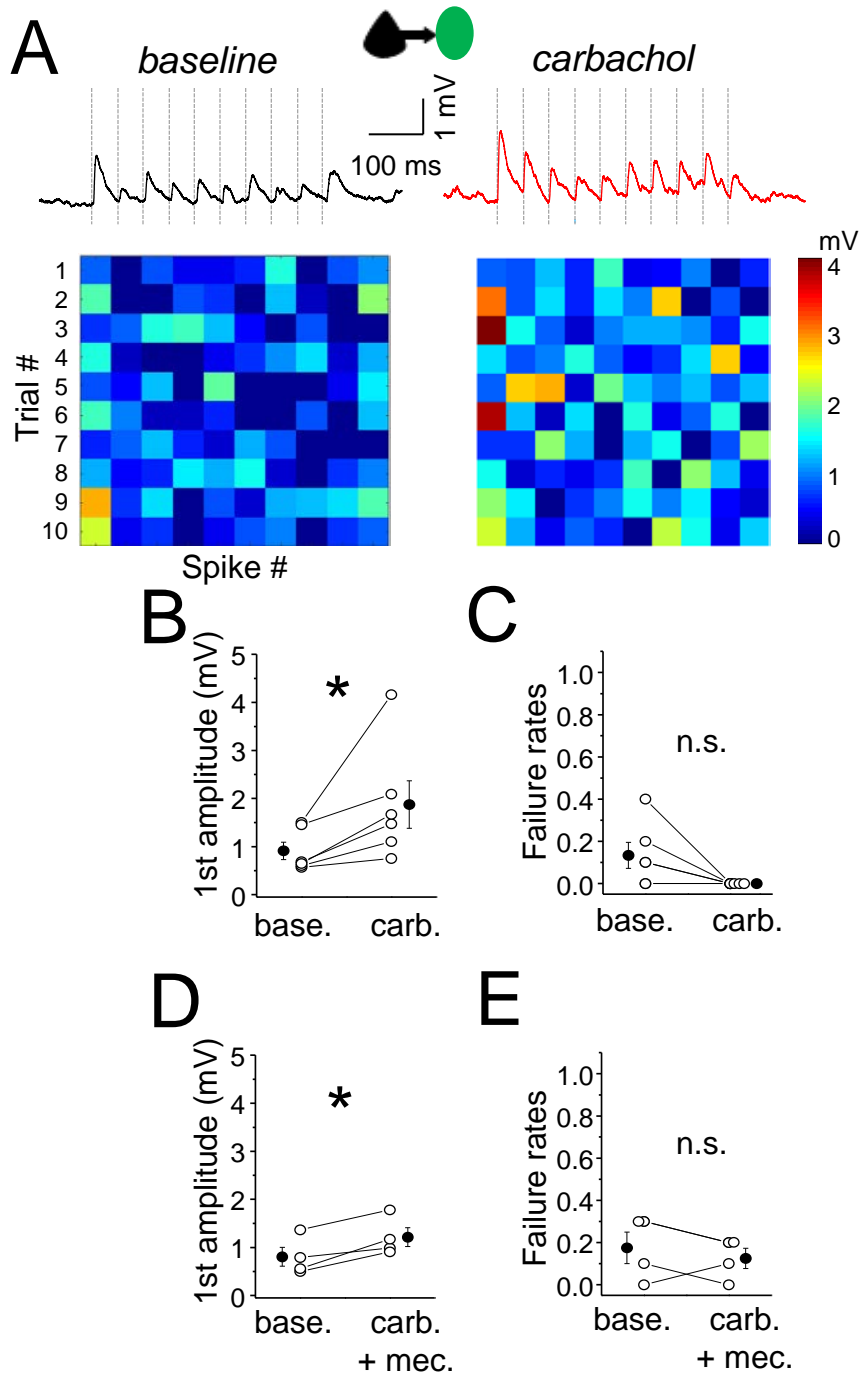
Supplemental Figure 4 related to Figure 6. Anatomical and electrophysiological properties of Pyr and SST neurons in L2/3 mouse somatosensory cortex in vivo. (A) In vivo 2-photon image of a pyramidal neuron (green cell soma) connected to a SST interneuron (yellow cell soma). White dashed lines show recording electrodes outlines. **(B)** Histogram of total numbers of tested connections (grey) with the numbers of connected Pyr-SST pairs (red) as a function of the depth from the pia between PYR neurons and SST neurons, black line shows linear regression between connectivity probably and depth from the pia. **(C)** Same as (B) but for intersomatic distance between Pyr-SST paired recording. **(D)** Example firing pattern of Pyr (black) and SST neuron (red). **(E)** Mean V_m in Pyr is more hyperpolarized than in SST neurons. **(F)** SST has larger input resistance than Pyr neurons. **(G)** Pyr neurons have a faster membrane time constant (Tau). **(H)** Pyr and SST have similar spontaneous firing rate. **(I)** Pyr and SST neurons have similar spike threshold. **(J)** Pyr and SST neurons have similar spike half-width.

Supplemental Figure 5 (related to Figure 7)



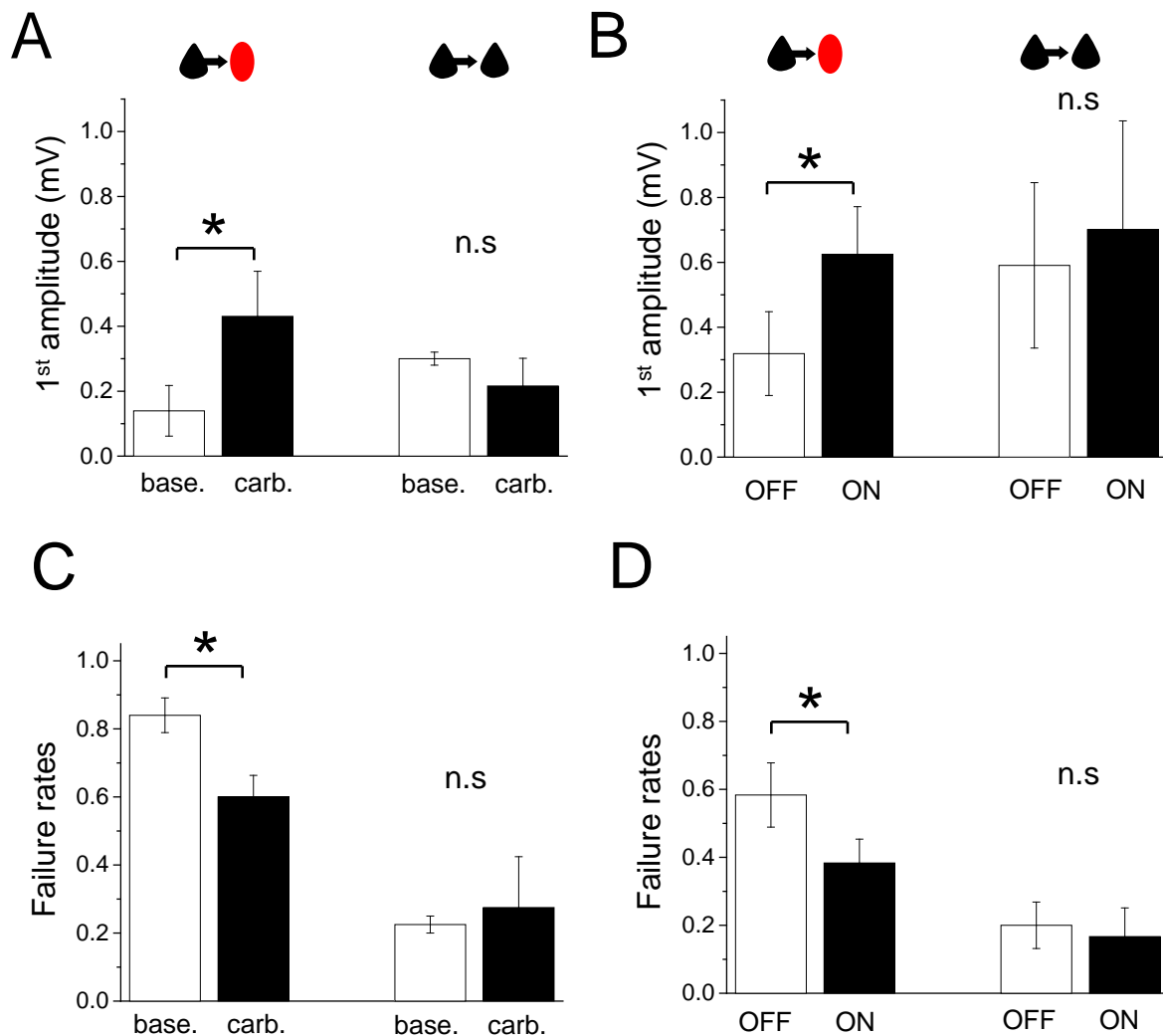
Supplemental Figure 5 related to Figure 7. EPSPs are stable during long recordings in the presence of PKI in the presynaptic cells. Black open circles represent mean EPSP amplitude in response to the first spike in the train recorded every 10 s, open gray symbols represent individual experiments. A blue square indicates light ON period. The plot represent mean and SEM (n=8).

Supplemental Figure 6 (related to Figure 8)



Supplemental Figure 6 related to Figure 8. Pyr-PV connection analysis with pharmacological agents. (A) The averaged trace of 10 response trials for a Pyr to PV connection under baseline conditions (left) and in carbachol. Ten presynaptic spikes (dashed vertical lines) at 20 Hz were delivered. (B) Mean EPSP amplitude in response to the first spike in the train, for baseline and in carbachol conditions. (C) Mean failure rate after the first spike, for both conditions. (D) and (E) The same as in (B) and (C) but with selective muscarinic receptor activation (carbachol and mecamylamine, a nicotinic receptor antagonist). For all, open circles represent individual cell measurements and filled circles represent all-cell mean \pm SEM, respectively (B-E).

Supplemental Figure 7 (related to Figure 8)



Supplemental Figure 7 related to Figure 8. Comparison of pharmacological and endogenous cholinergic receptor activation for Pyr-SST and Pyr-Pyr excitatory connections. (A) Mean EPSP amplitude for baseline condition (base.) and in the presence of carbachol (carb.) **(B)** The same as in (A) but for light OFF and ON conditions. **(C)** Mean failure rate after the first spike, for baseline and carbachol conditions. **(D)** The same as in (C) but for light OFF and ON conditions. The bar graphs represent mean and SEM.

Supplemental Table 1

SST	baseline	carbachol	baseline	carbachol + mec. ^	baseline	carbachol + atropine
V_{rest} (mV)	-55.26±2.14 (8)	-47.40±1.48*	-55.95±2.44 (6)	-51.38±2.35*	-56.04±1.72 (6)	-53.11±1.03
R_{in} (MΩ)	516±76	561±56	588±89	475±72*	604±75	670±76
Activity^^ (Hz)	2.013±1.024	5.341±1.605*	0.713±0.548	3.470±0.682*	1.727±0.637	2.447±0.838*
Pyr						
V_{rest} (mV)	-67.77±1.08 (12)	-63.38±0.95*	-65.97±1.89 (6)	-60.46±2.82*	-65.66±1.61 (6)	-65.48±1.94
R_{in} (MΩ)	361±70	365±53	296±52	315±72	281±68	244±34
Activity^^ (Hz)	0.003±0.002	0	0.040±0.040	0.003±0.003	0.020±0.015	0.028±0.028

Supplemental Table 1. Membrane properties and spontaneous activity of SST and pyramidal neurons after the application of cholinergic pharmacological agents.

^ mecamylamine

^^ spontaneous activity

*p<0.05, Wilcoxon test