

Supplementary Information for

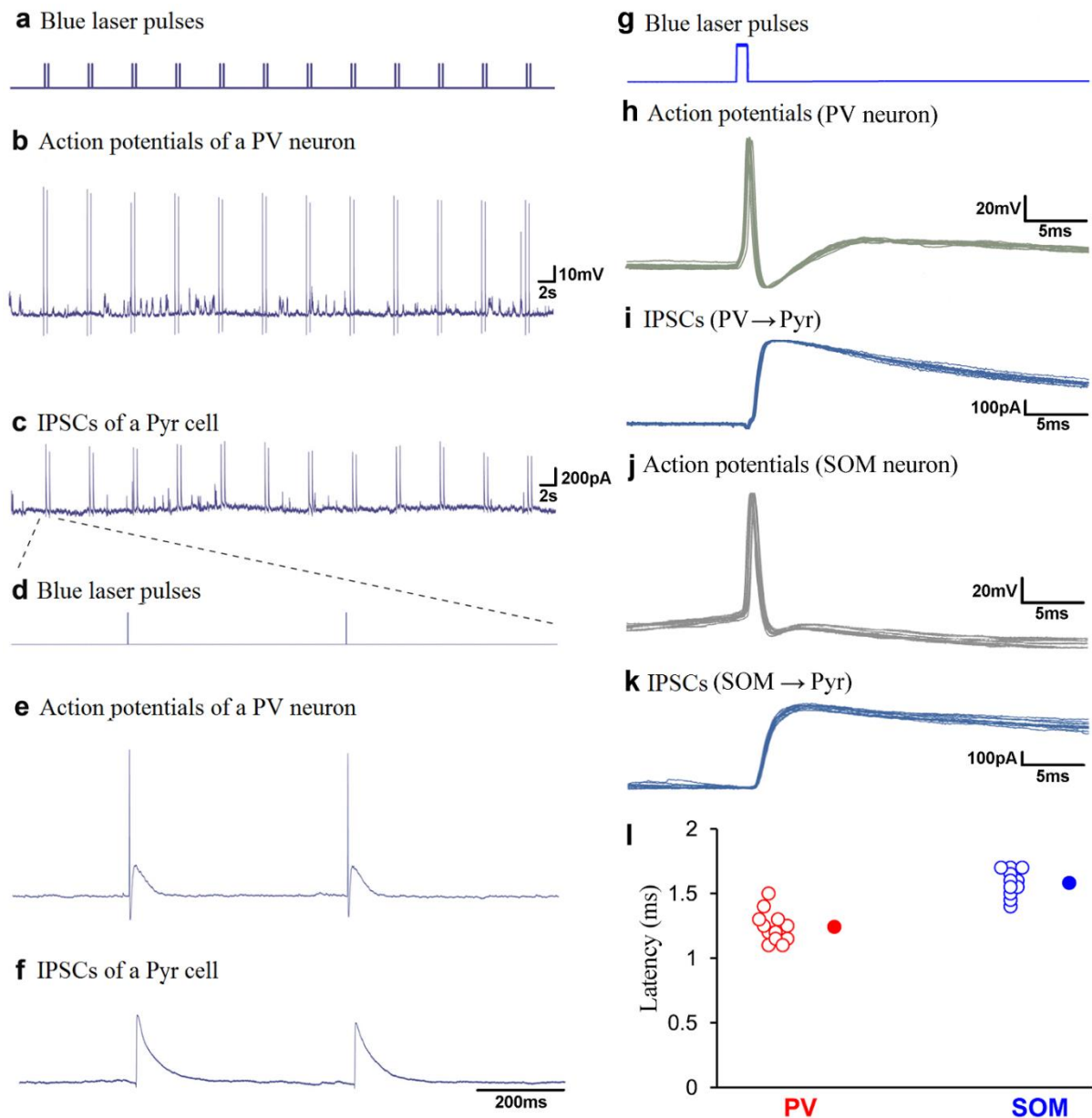
**Parvalbumin-expressing interneurons can act solo while  
somatostatin-expressing interneurons act in chorus in most cases on  
cortical pyramidal cells**

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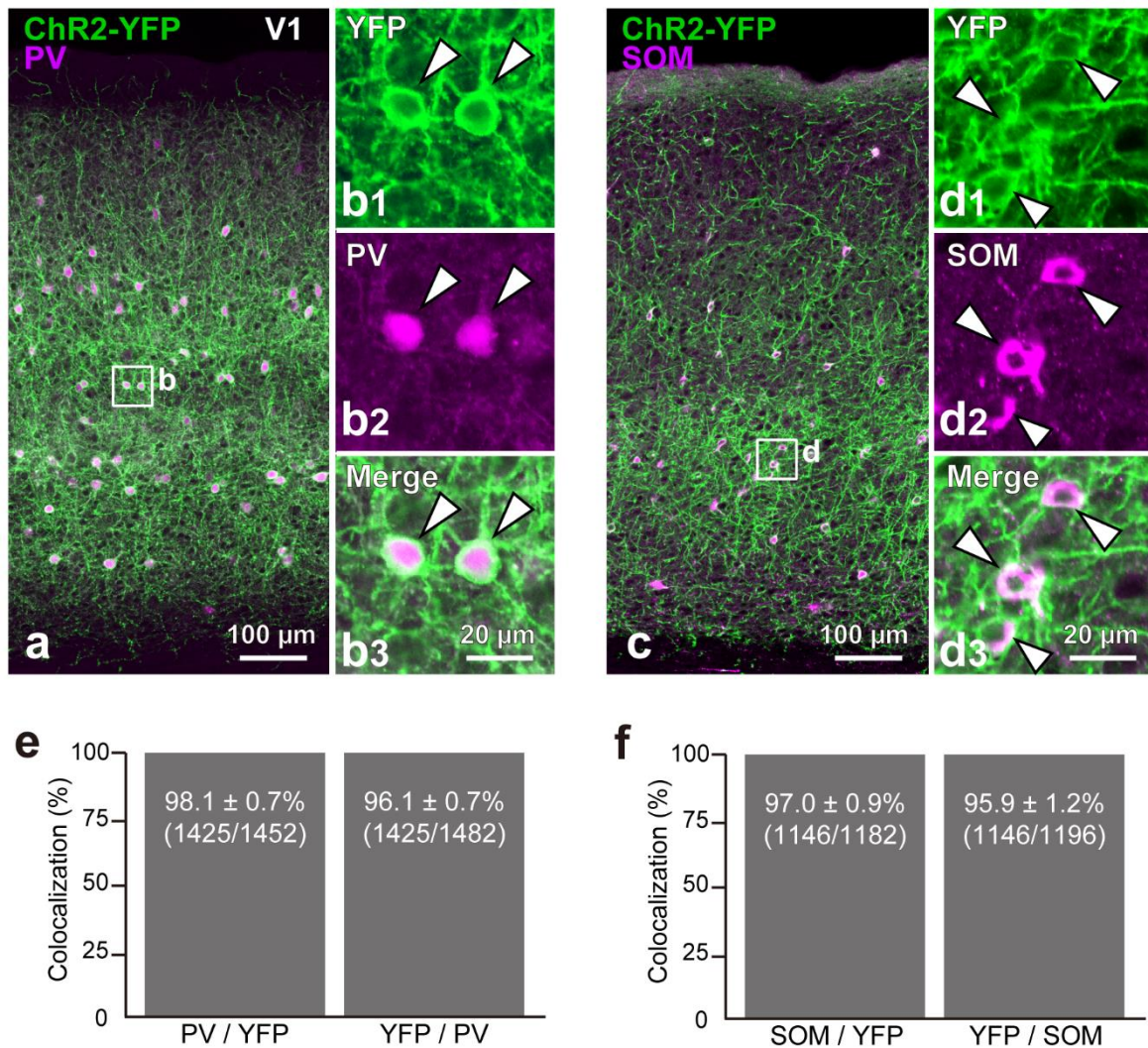
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Supplementary Figures S1 to S5



### Supplementary Figure S1.

**Photo-induced action potentials of interneurons and subsequently evoked IPSCs of Pyr cells.** (a) A pair of blue laser pulses (1 ms width each at the interval of 500 ms) applied to the visual cortex at the frequency of 0.16 Hz. (b) Action potentials of a PV neuron which were induced by laser pulses. The intensity of laser was adjusted so that each laser pulse generated single action potentials. (c) IPSCs of a Pyr cell evoked by action potentials of the PV neuron. (d-f) Parts of the traces a-c are shown at the expanded time scale, as indicated by dotted lines. (g-i) Parts of the traces d, e and f are further expanded at the faster time scale. (j) Action potentials of a SOM neuron which were induced by blue laser. (k) IPSCs of a Pyr cell evoked by action potentials of the SOM neuron. Superimposition of 12 sweeps in h-k. (l) Latencies of 12 PV and 11 SOM neurons from the onset of laser pulse to the peak of action potentials. The means  $\pm$  SEM are  $1.24 \pm 0.03$  and  $1.58 \pm 0.03$  ms for PV and SOM neurons, respectively.



### Supplementary Figure S2.

**Specific expression of ChR2 in PV or SOM neurons.** (a) The immunoreactivity for YFP and PV was visualized with AlexaFluor488 (green) and Cy3 (magenta), respectively. (b1-3) Magnified image of the area indicated by rectangle in a. (b1, b2) Stained by antibody as indicated. (b3) Superimposed image of b1 and b2. Arrowheads indicate the co-localization. (c) The immunoreactivity for YFP and SOM was visualized with AlexaFluor488 (green) and Cy3 (magenta), respectively. (d1-3) Magnified image of the area indicated by rectangle in c. Other conventions are the same as in b1-3. (e) Expression of ChR2 in PV neurons. The values indicated were obtained from 9 sections of three mice. (f) Expression of ChR2 in SOM neurons. Other conventions are the same as in e.

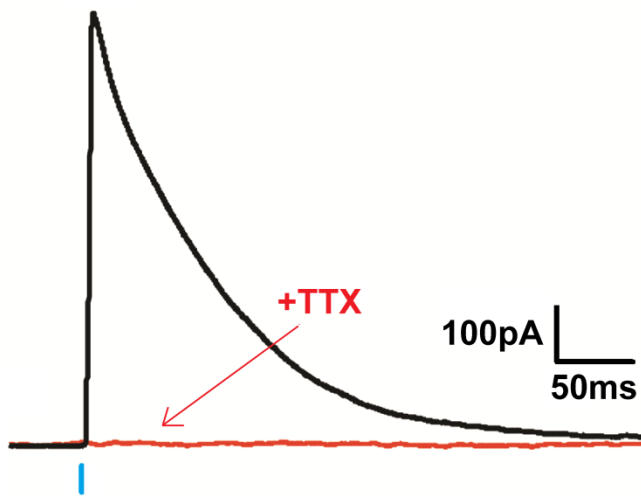
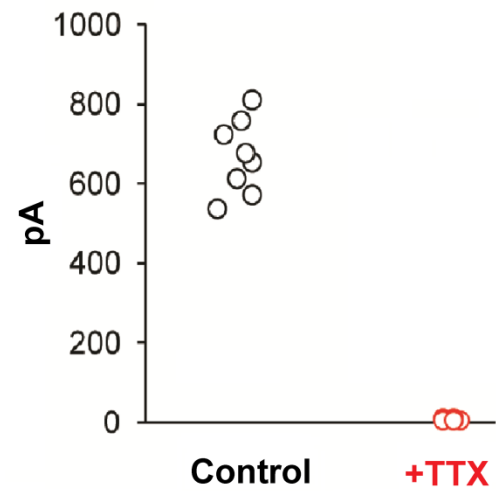
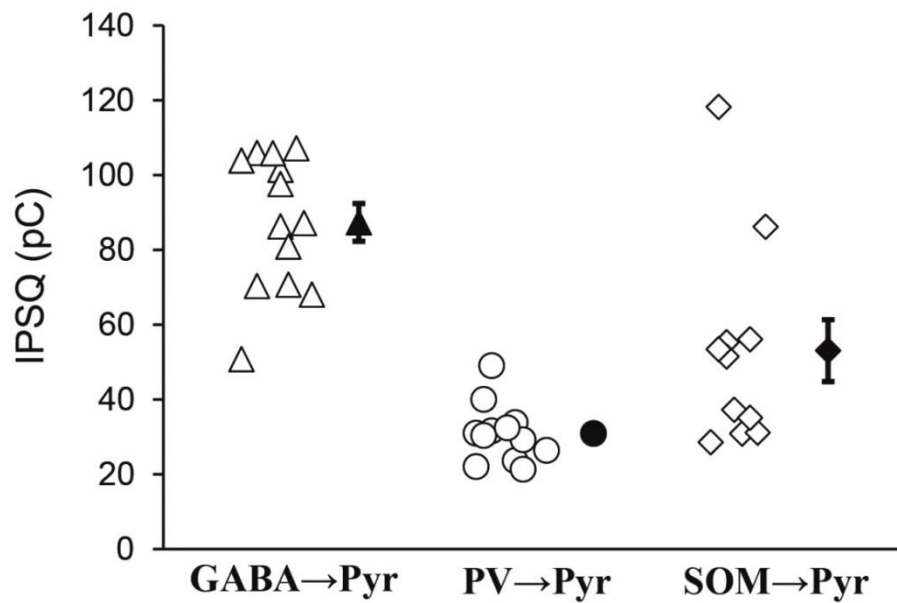
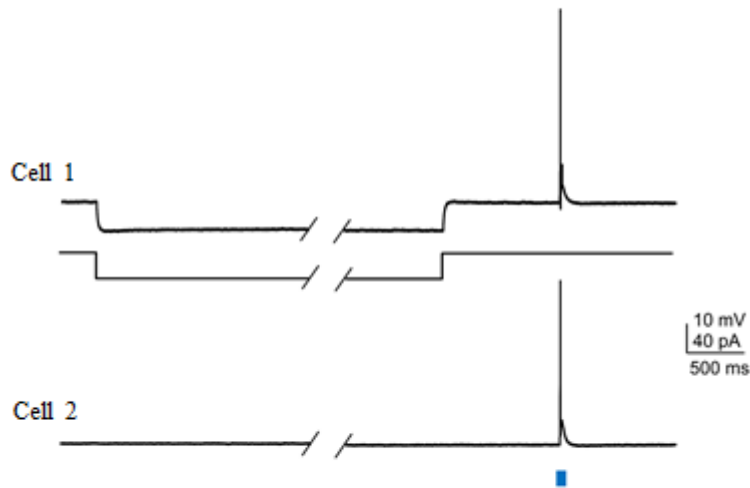
**a** Photo-induced pIPSC**b** Peak amplitude of pIPSC**Supplementary Figure S3**

Photo-induced IPSC is dependent on action potential. **(a)** Laser pulse stimulation at the 1 ms width (shown by vertical blue line at the bottom) induced IPSC of a Pyr cell (black trace) and this IPSC was completely abolished by bath application of tetrodotoxin (TTX) at 1  $\mu$ M, shown by red trace. **(b)** Peak amplitude of IPSCs of 8 Pyr cells before (control) and after the application of TTX (+TTX). The means  $\pm$  SEM are  $667 \pm 33$  and  $5.75 \pm 0.7$  pA for Control and +TTX conditions, respectively.



#### Supplementary Figure S4.

**Total charge of population IPSCs of pyramidal cells.** The mean total charges of currents (IPSQs) were  $87.5 \pm 5.0$  pC ( $n=13$ ),  $30.9 \pm 2.3$  pC ( $n=12$ ) and  $53.1 \pm 8.3$  pC ( $n=11$ ) for whole GABA→Pyr, PV→Pyr and SOM→Pyr connections, respectively. The data for the PV→Pyr and SOM→Pyr connections are the same as those shown in Figure 2f. The sum of the mean total charge of currents evoked from PV and SOM neurons ( $30.9+53.1=84.0$  pC) was 96% of those from whole GABAergic neurons (87.5 pC).



### Supplementary Figure S5.

**No effect of injection of hyperpolarizing currents into a PV cell on membrane potential of a neighboring PV cell.** Hyperpolarizing currents of 40 pA for 20 s were injected into the cell 1. The center-to-center distance between the two cells in the sliced visual cortex was 30  $\mu\text{m}$ . After stopping the current injection blue light (wave length, 473 nm) was irradiated for 1 ms to the slice containing the two cells to test the condition of the cells. Generation of action potentials confirmed that the cell 2 as well as the cell 1 were intact. The scale of 40 pA applies to the injected currents (second row) and that of 10 mV applies to the membrane potentials.