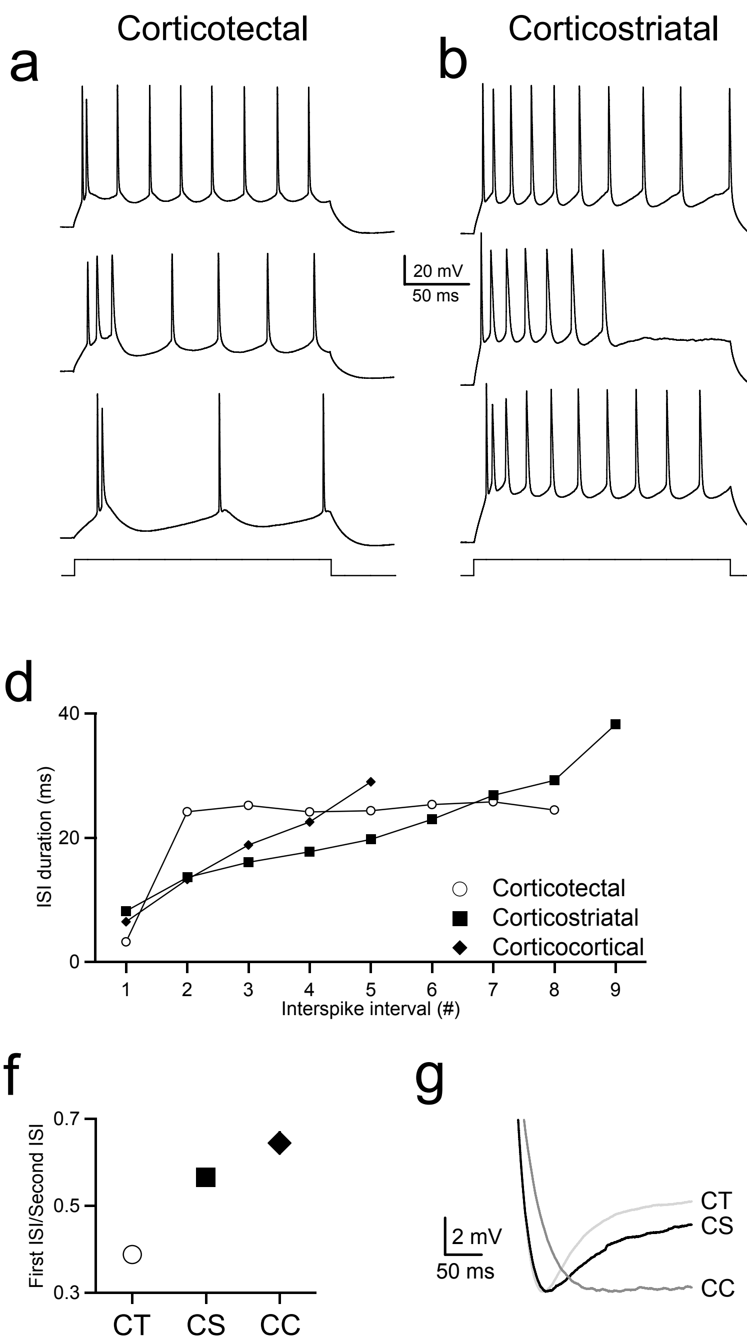

Brown and Hestrin
Supplementary Figure 1

Supplementary Figure 1 Electrophysiological properties of corticotectal, corticostriatal and corticocortical pyramids. Responses to a 200 ms injection of current from three different corticotectal cells (**a,** top: 700 pA, middle: 250 pA, bottom: 250 pA), three different corticostriatal cells (**b,** top: 600 pA, middle: 1000 pA, bottom: 1000 pA), and three different corticocortical cells (**c,** top: 600 pA, middle: 250 pA, bottom: 400 pA), respectively. **d,** The interspike intervals for the cells in the top panels of **a**, **b** and **c** are plotted. **e,** The average adaptation index (see Full Methods) for corticotectal cells (n = 64), corticostriatal cells (n = 26) and corticocortical cells (n = 21, $P < 1 \times 10^{-19}$, one-way ANOVA). An adaptation index of zero indicates no adaptation in the spike rate while a positive adaptation index indicates an adapting spike train. **f,** The ratio of the first interspike interval to the second interspike interval for corticotectal (n = 64), corticostriatal cells (n = 26) and corticocortical pyramids (n = 21, $P = 5.4 \times 10^{-14}$, one-way ANOVA). **g,** The initial recovery of a corticotectal cell, a corticostriatal cell and a corticocortical cell following a hyperpolarization step (average of 10 traces, CT, CS: -200 pA; CC: -100 pA). The resting potential was between -71 and -72.5 mV for all three cells. The response of the corticotectal cell has been offset by 1 mV and the corticocortical cell by -0.6 mV. **h,** The average time constants of the “sag” for corticotectal cells (n = 62) and corticostriatal cells (n = 25; $P = 1.5 \times 10^{-19}$, *t*-test). Corticocortical cells did not have a reliable sag response and are not plotted. The error bars in **e**, **f**, and **h** are largely obscured by the symbols.

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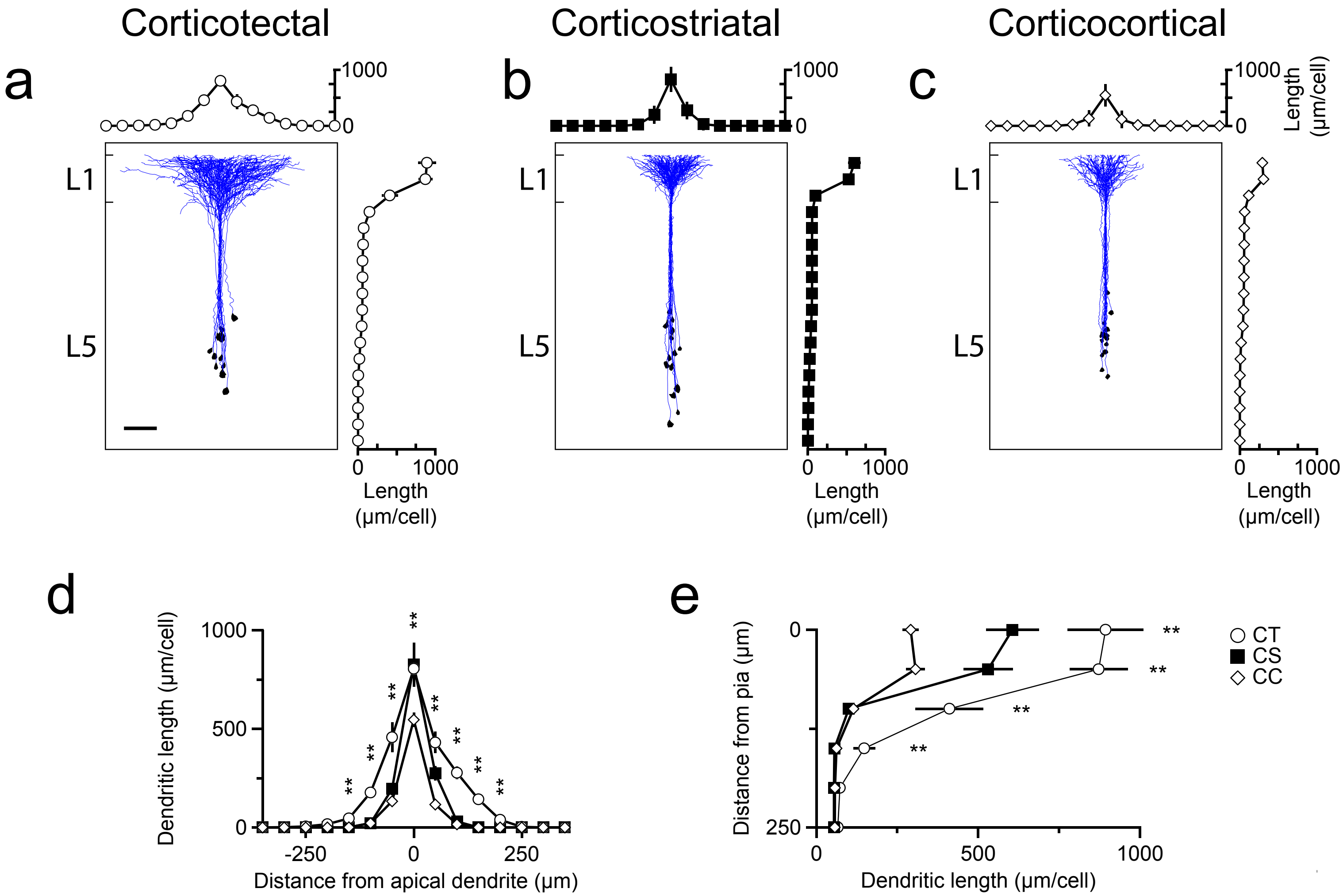

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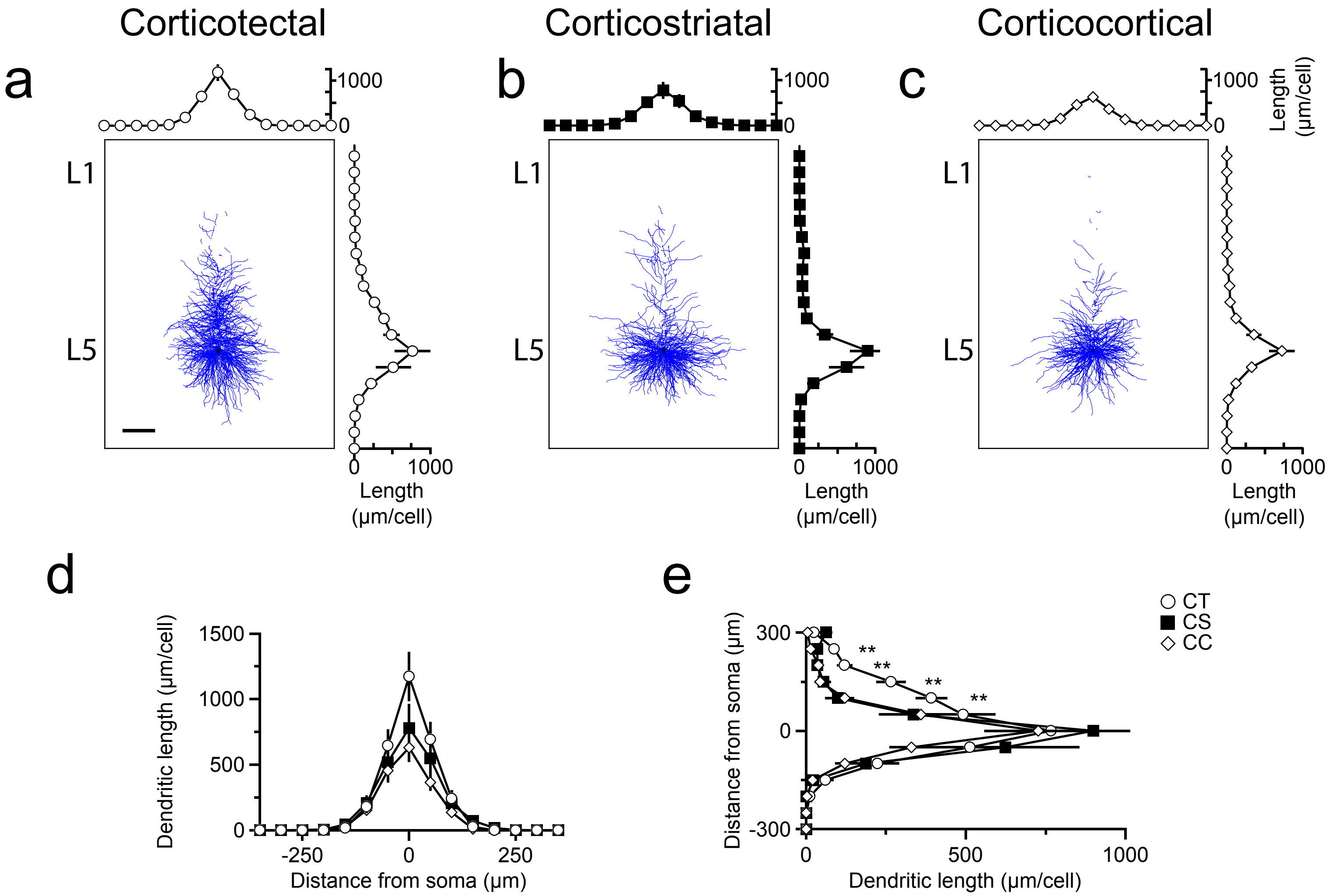
Supplementary Figure 2

Supplementary Figure 2 Corticotectal neurons have significantly larger apical tufts than corticostriatal or corticocortical pyramids. The apical tufts of 15 corticotectal cells **(a)** 15 corticostriatal cells **(b)** and 15 corticocortical pyramids **(c)** were aligned relative to the pial margin and superimposed (somas: black; dendrites: blue). The average dendritic length per cell was calculated for the horizontal dimension (left graphs, 50 µm layers). To limit the analysis to the apical tuft, the average dendritic length per cell was calculated for the first 250 µm from the pia (top graphs, 50 µm columns) in the vertical dimension. **d,** The data from the top graphs in **a**, **b** and **c** have been superimposed to compare the lateral extent of the dendritic branching in the apical tufts. **e,** The data from the graphs to the right of **a**, **b** and **c** have been superimposed to compare the vertical extent and the density of the apical tufts. Scale bar, 100 µm. **$P \leq 0.01$ (Kruskal-Wallis test).



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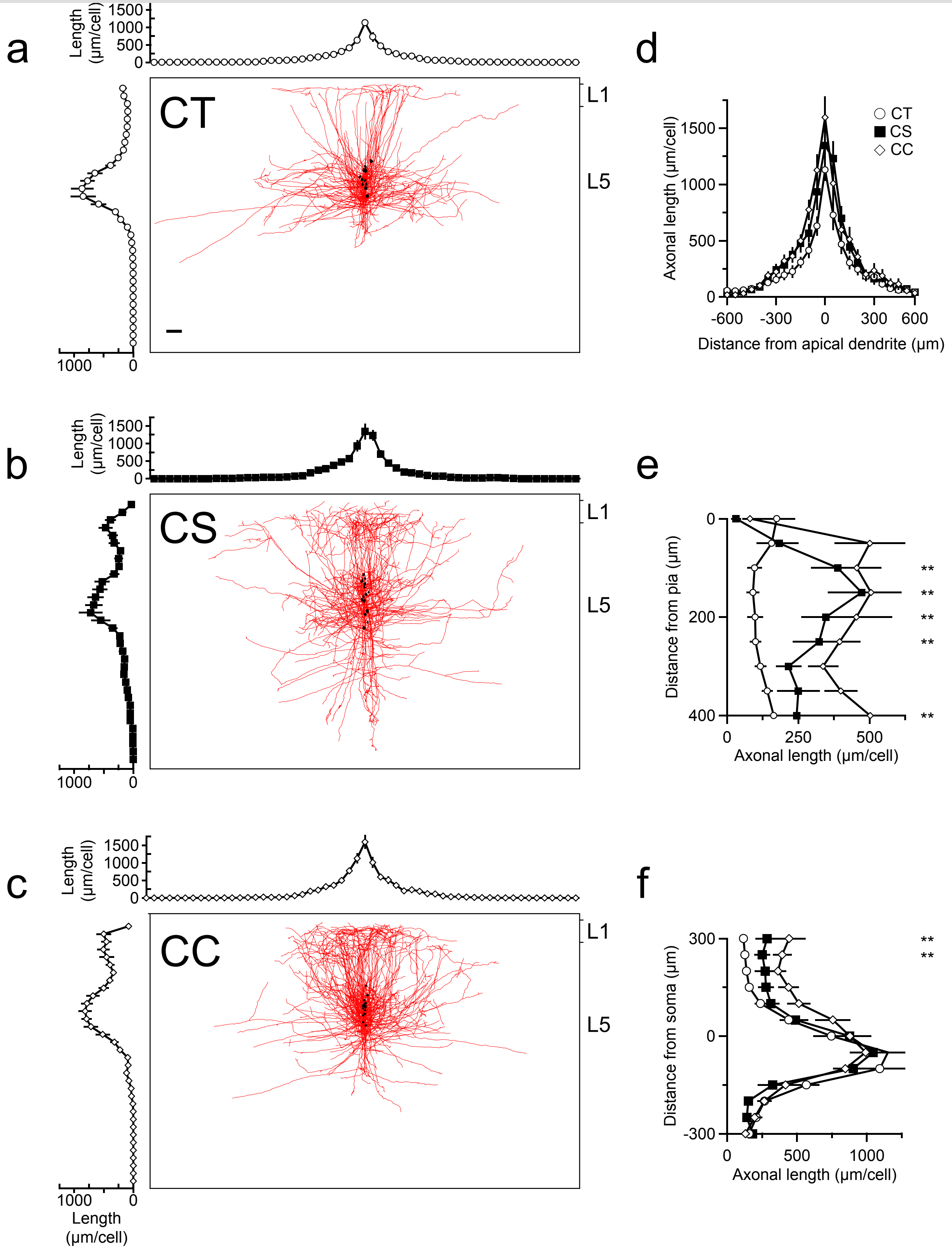
Supplementary Figure 3

Supplementary Figure 3 Corticotectal neurons have significantly more oblique dendrites than corticostriatal or corticocortical pyramids. The basal and oblique dendrites (blue) of 15 corticotectal cells **(a)**, 15 corticostriatal cells **(b)** and 15 corticocortical cells **(c)** were aligned relative to their cell bodies (black) and superimposed. The average dendritic length per cell was calculated for the horizontal dimension (right graphs, 50 µm layers). The average dendritic length per cell was also calculated in the vertical dimension (top graphs, 50 µm columns). **d,** The data from the top graphs in **a, b** and **c** have been superimposed to compare the lateral extent of the basal and oblique dendrites. **e,** The data from the graphs to the left in **a, b** and **c** have been superimposed to compare the vertical distribution of the basal and oblique dendrites. Scale bar, 100 µm. $^{**}P \leq 0.01$ (Kruskal-Wallis test).



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Supplementary Figure 4

Supplementary Figure 4 Although the total axonal length for the three cell types was similar, corticostriatal and corticocortical neurons both send an exuberant axonal projection into the supragranular layers which were not targeted by local corticotectal axons. The local axonal arbors of 15 corticotectal cells **(a)**, 15 corticostriatal cells **(b)** and 15 corticocortical pyramids **(c)** were aligned relative to the pial margin and superimposed (somas: black; axons: red). The average axonal length per cell was calculated for the horizontal (left graphs, 50 µm layers) and vertical dimensions (top graphs, 50 µm columns). **d,** The data from the top graphs in **a, b** and **c** have been superimposed showing the similarity in total axonal processes for the three cell types. **e,** The data in the graphs to the left of the reconstructions has been superimposed to compare the distribution of axonal projections in the supragranular layers. **f,** The neurons were aligned relative to their somas and the distribution of the perisomatic axonal projections was plotted for the three cell types. Scale bar, 100 µm. $^{**}P \leq 0.01$ (Kruskal-Wallis test).

Supplementary Table 1. Physiological properties of CT, CS and CC pyramids

	Corticotectal	Corticostriatal	Corticocortical	P value
V_m	-67.5 ± 0.4 mV (n = 68)	-72.0 ± 0.7 mV (n = 26)	-71.6 ± 0.7 mV (n = 54)	2.94×10^{-8}
R_{input}	94.1 ± 4.6 mΩ (n = 68)	136.8 ± 8.8 mΩ (n = 26)	243.7 ± 11.8 mΩ (n = 54)	$< 1 \times 10^{-19}$
1st ISI/2nd ISI	0.39 ± 0.02 (n = 64)	0.57 ± 0.02 (n = 26)	0.64 ± 0.03 (n = 21)	5.42×10^{-14}
Adaptation index	0.028 ± 0.005 (n = 64)	0.129 ± 0.009 (n = 26)	0.155 ± 0.023 (n = 21)	1.11×10^{-16}
Sag time constant	67 ± 3 ms (n = 62)	150 ± 7 ms (n = 25)	NA	1.52×10^{-19}

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Supplementary Table 2. Properties of unitary EPSPs among CT, CS or CC neurons and between CT and CC pyramids

	CT→CT	CS→CS	CC→CC	CT→CC	CC→CT	P value
Amplitude (μV)	257 ± 45 (n = 16)	383 ± 67 (n = 7)	490 ± 174 (n = 6)	333 ± 86 (n = 4)	511 ± 156 (n = 16)	0.49
Latency (ms)	1.17 ± 0.09 (n = 7)	0.87 ± 0.10 (n = 5)	1.42 ± 0.40 (n = 4)	1.46 ± 0.09 (n = 3)	1.04 ± 0.22 (n = 9)	0.40
Variability of latency (ms)	0.34 ± 0.09 (n = 7)	0.36 ± 0.05 (n = 5)	0.52 ± 0.14 (n = 4)	0.43 ± 0.10 (n = 3)	0.33 ± 0.05 (n = 9)	0.56
Rise time (ms)	1.49 ± 0.12 (n = 7)	1.52 ± 0.11 (n = 5)	1.84 ± 0.23 (n = 4)	1.57 ± 0.26 (n = 3)	1.50 ± 0.14 (n = 9)	0.61
Coefficient of variation	0.34 ± 0.06 (n = 10)	0.20 ± 0.03 (n = 6)	0.43 ± 0.17 (n = 6)	0.32 ± 0.04 (n = 4)	0.22 ± 0.02 (n = 16)	0.14
Paired pulse ratio	0.82 ± 0.20 (n = 8)	0.55 ± 0.05 (n = 6)	0.54 ± 0.17 (n = 6)	0.33 ± 0.09 (n = 4)	0.57 ± 0.05 (n = 16)	0.47