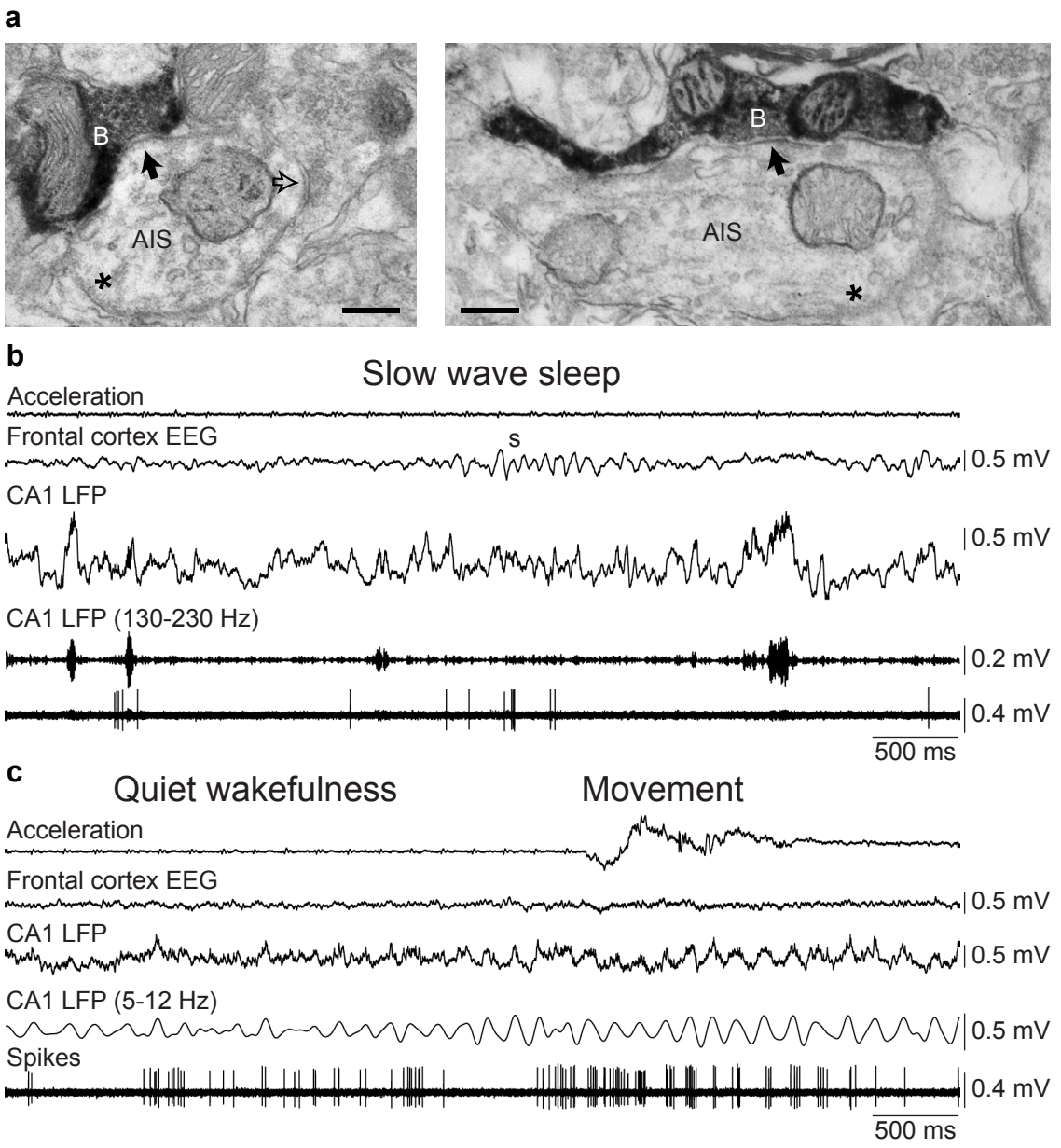
Network state-dependent inhibition of identified hippocampal CA3 axo-axonic cells in vivo. Tim J Viney*, Balint Lasztoczi*, Linda Katona*, Michael G Crump*, John J Tukker, Thomas Klausberger, Peter Somogyi



Supplementary Figure 1. A CA1 axo-axonic cell recorded in a freely moving rat is inhibited during sharp waves. (**a**) Left, a bouton (B) of cell TV34n filled with electron opaque HRP reaction end-product making a type II synapse (filled arrow) with a pyramidal cell AIS (identified by the dense membrane undercoating, asterisk); open arrow, a type II synapse with an unlabeled bouton. Right, another bouton of the same cell. Scale bars, 0.2 μm. (**b** and **c**) Firing patterns of the identified AAC TV34n during (**b**) SWS and (**c**) during quiet wakefulness and head movement. Movement is detected by an accelerometer; spindles (s) are present in the EEG during SWS.

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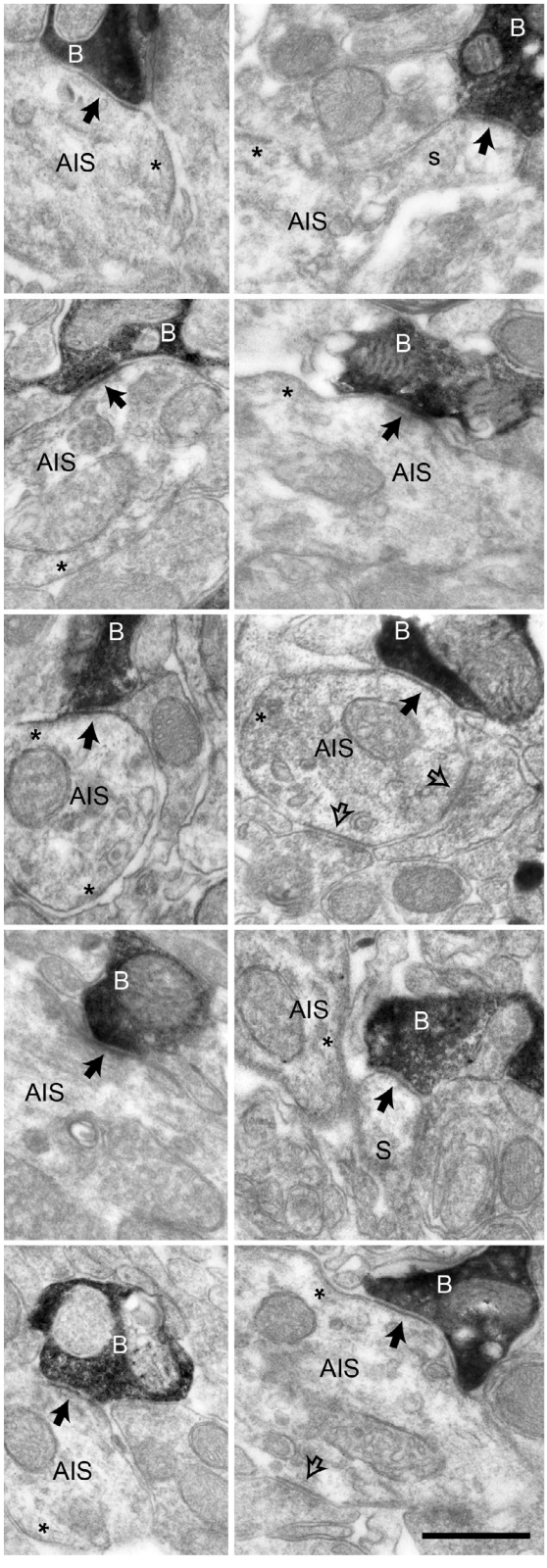

Supplementary Figure 2. Synaptic junctions between the boutons of identified CA3 axo-axonic cells and axon initial segments of pyramidal cells.

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Supplementary Figure 2 (continued). Ten electron micrographs taken from serial sections of neurobiotin-labeled (HRP end-product) boutons (B) of AAC B45a making type II synapses (arrows) with AISs, identified by membrane undercoating (asterisks) and/or microtubule fascicles. Unlabeled boutons also make similar synapses (open arrows). Spines (s) from AISs, described previously (ref. 19), also receive one or more AAC synapses. Sections were not contrasted by lead. Scale for all images: 0.5 μm.

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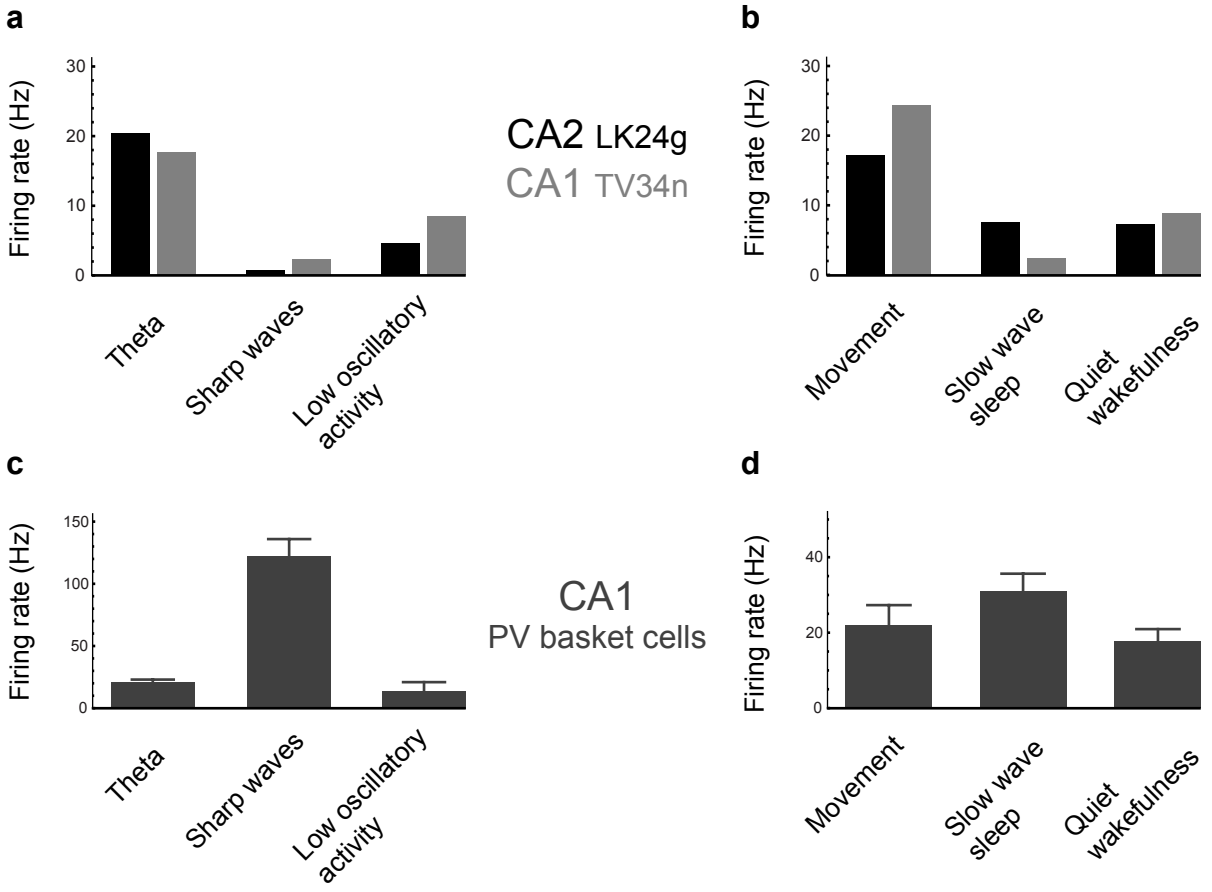

Supplementary Figure 3. State-dependent firing rates of identified axo-axonic cells in freely moving rats. (**a** and **b**) Firing rates of identified CA2 AAC LK24g (black) and CA1 AAC TV34n (gray) during (**a**) network oscillations and (**b**) behavioral states. (**c** and **d**) Mean ± s.e.m. firing rates of 5 published identified parvalbumin-expressing basket cells (ref. 20) for comparison with the AACs. Note the different rates during sharp waves when compared to theta oscillations.

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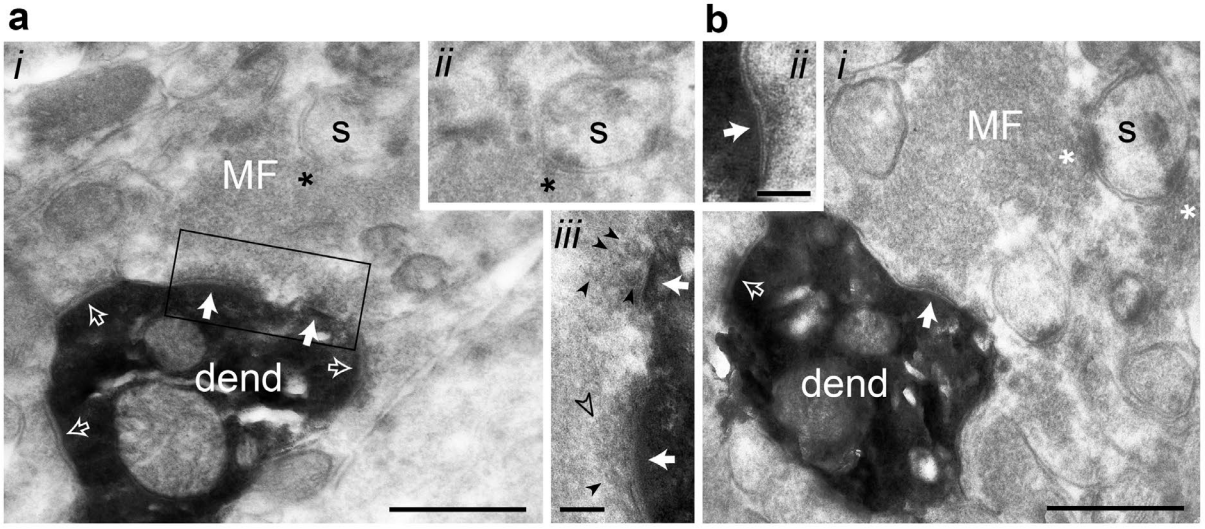

Supplementary Figure 4. Innervation of axo-axonic cell dendrites by mossy fiber terminals. (**a**,**i**) Electron micrograph of a neurobiotin-labeled AAC dendrite in sLuc (dend, cell B45a) receiving synaptic input (filled white arrows) from a large mossy fiber bouton (MF) recognized by dense vesicular filling. Unfilled white arrows, synapses made by boutons other than the large mossy terminal; s, invaginated spine from a thorny excrescence of a CA3 pyramidal cell dendrite. (**a**,**ii**) Serial section of the spine (s) with synaptic junction (asterisk). (**a**,**iii**) Enlargement of synaptic junctions in **i** (white arrows). Image captured at a different angle of tilt. Black arrowheads, synaptic vesicles; open arrowhead, dense core vesicle. (**b**) Same as in **a**,**i**; another large mossy terminal (MF) making a synapse (white arrow, see inset **b**,**ii**) onto the same dendrite. Asterisks, synapses by the mossy terminal on a pyramidal cell spine (s). Sections were not contrasted by lead. Scale bars: **a**,**i**, **a**,**ii**, **b**,**i**, 0.5 μm; **a**,**iii**, **b**,**ii**, 0.1 μm.

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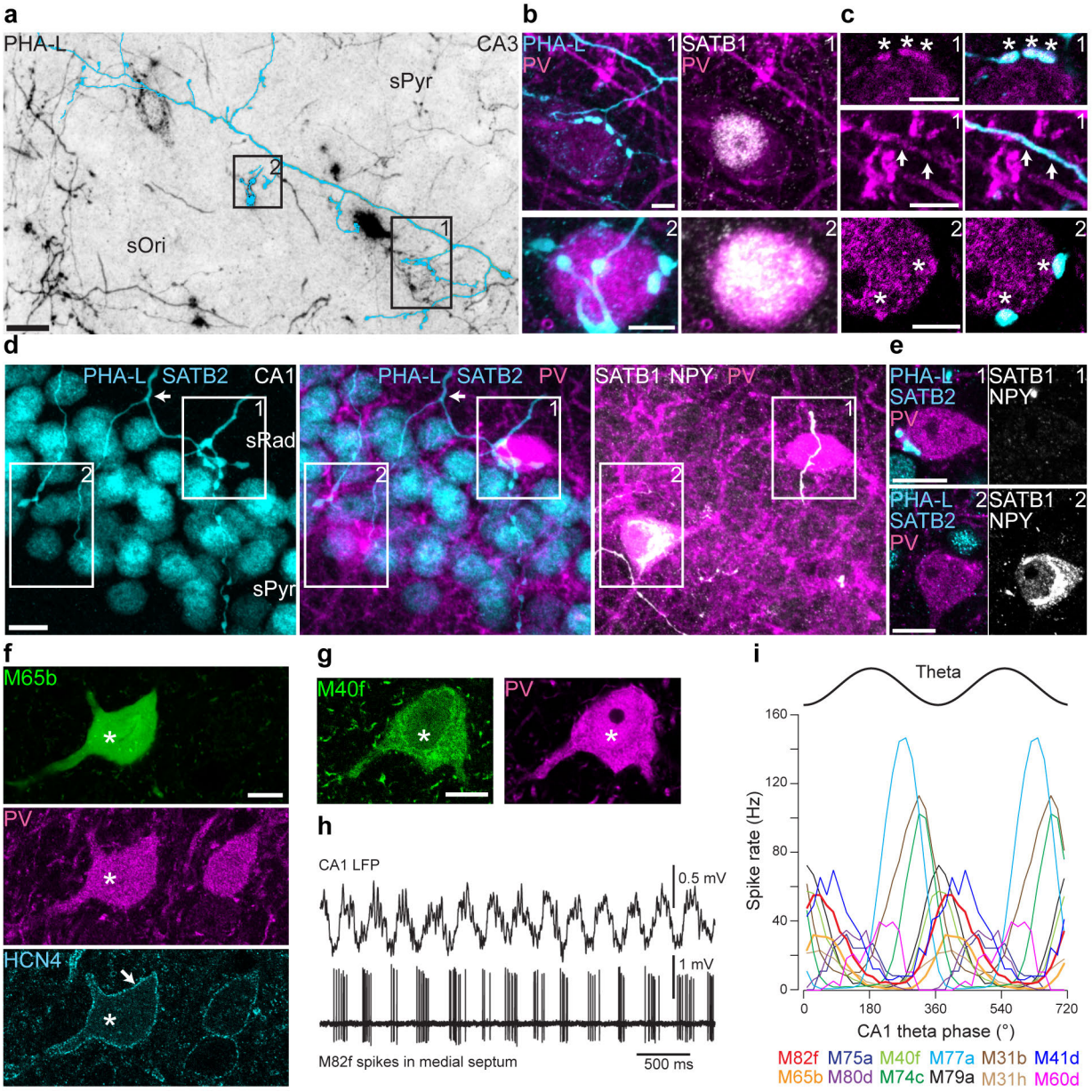

Supplementary Figure 5. Preferential targets of septo-hippocampal neurons and firing patterns of medial septal cells. (**a**) Digital trace (cyan) of a PHA-L-labeled septal axon preferentially targeting SATB1+/PV+ interneurons (unconnected PHA-L+ axons are black). (**b**) Left, septal-innervated PV+ somata from boxes 1 and 2 in **a**. Right, SATB1+ nuclei of same cells. (**c**) Single optical sections of parvalbumin-immunoreactivity from **b** shown with and without PHA-L-immunoreactivity. PV+ septal boutons, asterisks; main axon, arrows.

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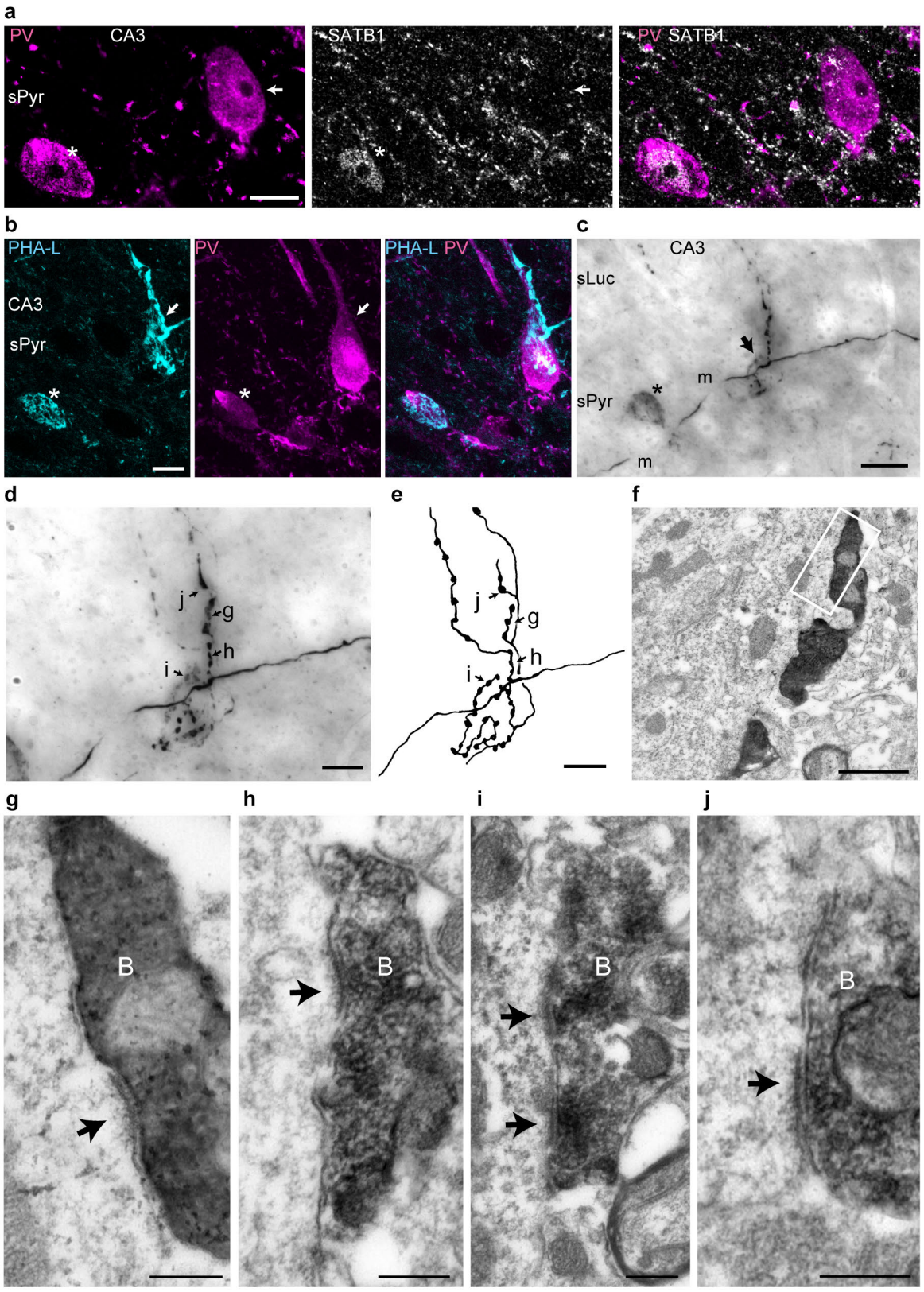
Supplementary Figure 5 (continued). (**d**) PHA-L-labeled septal axon (cyan, arrow) targeting a SATB1–/PV+ soma (magenta, in box 2) amongst SATB2+ CA1 pyramidal cells (cyan, nuclei). Another PV+ cell (in box 1), is SATB1+ and NPY+ (both white, nucleus and Golgi apparatus, respectively) and not innervated by the septal axon. Note NPY+ axons (white, e.g. inside boxed regions). (**e**) Single optical sections of both PV+ cells (from boxes 1 and 2 in **d**). Immunoreactivity for parvalbumin and PHA-L/SATB2 (left), and SATB1 and NPY (right). The septal innervated cell (from box 1) is SATB1– and NPY–. (**f** and **g**) Single optical sections of *in vivo* recorded neurobiotin-labeled medial septal cells M65b (**f**) and M40f (**g**). Parvalbumin, magenta; HCN4, cyan; asterisks, somata; arrow, plasma membrane. (**h**) Firing patterns of cell M82f (see Figure 7) during theta oscillations recorded in CA1. (**i**) Firing rate versus CA1 theta phase for medial septal cells. Same color code as in Fig. 7e and those identified with axons projecting to CA3 are shown with thick lines. Confocal z-stacks (number of optical sections / thickness in μm / intensity projection mode): **a**, 73/29/average (montage); **b** box 1, 52/15/average; box 2, 83/24/average; **d**, 84/32/average. Scale bars (μm): **a**, 20; **b**, **c**, **e**, 5; **d**, **f**, **g**, 10.



Supplementary Figure 6. Synapses between medial septal terminals and an axo-axonic cell identified by SATB1–/PV+ labeling.

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Supplementary Figure 6 (continued). (**a**) Median-filtered confocal z-projection of parvalbumin-immunoreactivity (magenta) in two CA3 neurons. One neuron (asterisk) shows nuclear SATB1 immunoreactivity (white), the other has no detectable SATB1 immunoreactivity (arrow). (**b**) Confocal z-projection of PHA-L-labeled boutons (cyan) apposed to the PV+ (magenta) SATB1–immunonegative neuron shown in **a** (arrow). The PV+/SATB1+ neuron in **a** is not innervated by PHA-L boutons (asterisk). Both cells contain endogenous biotin (cyan, somatic labeling) that is visualized by the streptavidin-conjugated Alexa Fluor secondary antibody bound to the biotinylated anti-PHA-L primary antibody. (**c**) Light microscopic image z-stack of the same area after converting PHAL-immunoreactivity to diaminobenzidine-based HRP reaction product (20X objective), showing PHA-L-innervated SATB1–/PV+ cell from **a**/**b** (arrow) revealing axon (partially myelinated, m) bypassing the SATB1+/PV+ cell (asterisk). Note endogenous biotin in the soma. (**d**) Light microscopic z-stack image of PHA-L-innervated cell (100X objective). (**e**) Two-dimensional reconstruction of the medial septal-innervated cell. Four boutons in **d** and **e** (marked **g**–**j**) correspond to the panels below. (**f**) Electron micrograph of PHA-L-labeled boutons apposed to the target cell. Boxed region is shown rotated in **g**. (**g**–**j**) Synaptic junctions (arrows) between PHA-L-labeled septal boutons (B) and the target AAC. Confocal z-stacks (number of optical sections / thickness in µm / intensity projection mode): **a**, 2 separate single optical z-sections in same x-y location superimposed / 1.1 / maximum; **b**, 9 (PHA-L) and 27 (parvalbumin) optical sections superimposed / 15.1 / maximum; **c**, 24 / 13.7 / minimum; **d**, 93 / 24.2 / minimum. Scale bars: **a**–**b**, **d**–**e**, 10 µm; **c**, 20 µm; **f**, 1 µm; **g**–**j**, 0.2 µm.

Identified medial septal neuron			**M82f**	**M65b**	**M75a**	**M80d**	**M40f**
Immunohistochemical test	Parvalbumin		+s	+ds	+d	+ad	+s
	SATB1			+n	+n	+n	+n
	HCN4		+ds	+ds	+s	+ds	
	Calretinin						–s
	VGAT		+a		+a	+a	
	NECAB 1		–d	–d	–d	–d	
	Calbindin					–ds	
	Kv1.1				–s	+s	
	Target of projection axon		CA3	CA3	Dorsal fornix	Dorsal fornix*	na
***In vivo* firing patterns**	CA1 SWRs	Rate during SWRs (Hz)	23.4	17.2	7.3	27.9	43.9
		Rate peri-SWR (Hz)	5.5	8.0	3.8	5.5	20.6
		Mann-Whitney U comparison (P value, α = 0.05)	10^{-10}	8×10^{-7}	0.002	4×10^{-37}	2×10^{-10}
		n (active)	27 (21)	34 (28)	33 (18)	68 (58)	57 (51)
	Theta firing rate (Hz)		23.1	11.7	12.8	13.4	20.0
	Theta coupling	Mean phase CA1 (°)	49.8	56.2	144.1	129.9	20.8
		Mean vector length CA1	0.55	0.67	0.58	0.68	0.69
		Rayleigh test P value (number of spikes)	$<10^{-100}$ (5434)	$<10^{-100}$ (4024)	4×10^{-16} (95)	4×10^{-54} (233)	$<10^{-100}$ (4074)
		Mean action potentials per cycle	6.0	2.7	3.5	3.5	5.2
		Active cycles (%)	99.1	96.5	93.1	94.4	98.7

Supplementary Table 1a.

Medial septal neuron (unlabeled)			**M74c**	**M77a**	**M79a**	**M31b**	**M31h**	**M41d**	**M60d**
***In vivo* firing patterns**	CA1 SWRs	Rate during SWRs (Hz)	23.0	36.5	18.0	35.3	65.2	30.6	13.7
		Rate peri-SWR (Hz)	10.6	15.7	8.4	4.3	39.0	14.1	8.9
		Mann-Whitney U comparison (P value, α = 0.05)	10^{-5}	4×10^{-5}	3×10^{-8}	9×10^{-33}	4×10^{-5}	0.003	0.002
		n (active)	49 (34)	59 (42)	60 (45)	45 (38)	31 (31)	22 (17)	47 (33)
	Theta firing rate (Hz)		28.9	49.5	24.1	11.4	46.9	31.8	14.2
	Theta coupling	Mean phase CA1 (°)	318.3	269.9	14.8	32.9	302.7	71.0	207.3
		Mean vector length CA1	0.76	0.73	0.68	0.46	0.56	0.46	0.65
		Rayleigh test P value (number of spikes)	$<10^{-100}$ (8942)	$<10^{-100}$ (32364)	$<10^{-100}$ (8339)	$<10^{-100}$ (4370)	$<10^{-100}$ (3761)	2×10^{-33} (330)	8×10^{-24} (113)
		Mean action potentials per cycle	7.3	10.0	5.4	3.4	12.4	7.9	3.8
		Active cycles (%)	99.1	99.8	99.6	90.6	99.0	95.5	96.8

Supplementary Table 1b.

Supplementary Table 1 (a and b). Properties of sharp-wave-activated medial septal neurons. (+,–) indicates positive and negative immunoreactivity, respectively. Measurement location: s, soma; n, nucleus; d, dendrites; a, axons; na, not available. *Minor branches observed in medial CA1 and in subiculum.

Molecule	Host	Dilution and concentration (µg/ml)	Source	Code
Ankyrin-G	mouse	1:500, 1000	1	75-146, clone N106/36 (lot 441-4BK-91B)
Bassoon	mouse	1:500, 950	2	VAM-PS003, clone SAP7F407 (lot 901438)
Bassoon	guinea pig	1:500, antiserum	3	141004 (lot 3)
Calbindin	rabbit	1:5000, antiserum	4	CB-38 (lot 5.5)
Calretinin	rabbit	1:1000, antiserum	4	7699/3H (lot 18299)
ErbB4	mouse	1:1000, 200	5	MS-270-P, clone H4.77.16, same as Ab77
GABAAα1	rabbit	1:1000, 592	6	(Feb 2001 gift)
GABAAα1	guinea pig	1:300, 244	7*	(June 2011 gift)
Gephyrin	mouse	1:500, hybridoma supernatant	3	147 021 (lot 5), clone mAb7a/GlyR7a
Gephyrin	mouse	1:1000, 100	3	147 011 (lot 25)
Hyperpolarization-activated cyclic nucleotide-gated potassium channel 4 (HCN4)	mouse	1:500, 1000	1	clone N114/10 (lot 441-4BK-95Aa)
Kv1.1	mouse	1:1000, 1000	1	clone K36/15 (lot 440-5HK-57)
Metabotropic glutamate receptor 2/3 (mGluR2/3)	guinea pig	1:200, antiserum	7	(Feb 1996 gift)
Metabotropic glutamate receptor type 7b (mGluR7b)	guinea pig	1:2000, 830	7	K74 (Sept 2000 gift)
Neuronal Ca^{2+}-binding protein 1 (NECAB 1)	mouse	1:500, 500	8	H00064168-B01P (lot 09015 WUIZ)
Neuronal nitrogen oxide synthase (nNOS)	rabbit	1:1000, antiserum	9	AB5380 (lot 0507004069)
Neuropeptide Y (NPY)	sheep	1:700, antiserum	9	AB1583 (lot 25050288)

Neuropeptide Y (NPY)	rabbit	1:5000, antiserum	10	22940 (lot 208001)
Parvalbumin	guinea pig	1:5000, antiserum	3	195 004 (lot 5)
Parvalbumin	mouse	1:5000, ascites	4	235 (lot 10-11 F)
Parvalbumin	rabbit	1:500, antiserum	4	PV-28 (lot 5.5)
Parvalbumin	goat	1:2000, antiserum	4	PVG-214 (lot 3.6)
PHA-L	goat	1:5000, 2000	11	AS-2224 (lot T0817)
PHA-L	rabbit	1:500, 2000	11	AS-2300 (lot Q0205)
PHA-L-biotinylated	goat	1:1000, 1000	11	BA-0224 (lot M0724)
Pro-cholecystokinin	rabbit	1:500, 250	12	(April 2005 gift)
SATB1 (N-14)	goat	1:400, 200	13	sc-5989
SATB1 (N-14)	rabbit	1:1000, 1000	14	ab70004
SATB2	rabbit	1:1000, 100	14	ab34735
SATB2 (SATBA4B10)	mouse	1:200, 100	14	ab51502
Somatostatin (SOM)	mouse	1:200, 140	15	gtx71935, clone SOM-018
Vasoactive intestinal polypeptide (VIP)	rabbit	1:500, 1000	16	9535-0204 (lot 0109)
Vesicular GABA transporter (VGAT)	guinea pig	1:500, antiserum	3	131 004
Vesicular GABA transporter (VGAT)	rabbit	1:500, 600	12	Af500 (July 2003 gift)
Vesicular GABA transporter (VGAT)	rabbit	1:500, 1000	3	131 003 (lot 21)

Molecule (repeated)	**Host**	**Epitope**	**Specificity test**	**Notes**
Ankyrin-G	mouse	Monoclonal, fusion protein aa 990–2622, human Ankyrin-G.	No signal in knockout. Western blot; band at 270 kDa. Mouse cerebellar knockout: Zhou et al. (*The Journal of Cell Biology*, 1998, **143**, 1295–1599). Characterization: Jenkins and Bennett (*The Journal of Cell Biology*, 2001, **155**, 739–785).	a

Bassoon	mouse	Monoclonal, GST fusion protein aa 738–1035, rat bassoon.	Western blot; band at 420 kDa. Additional 350 kDa band and lower bands corresponding to putative proteolytic degradation products. Antibody generation and characterization: tom Dieck et al. (*The Journal of Cell Biology*, 1998, **142**, 499–1008).
Bassoon	guinea pig	Polyclonal, recombinant protein 330 C-terminal aa, rat bassoon.	Similar to mouse bassoon.
Calbindin	rabbit	Polyclonal, recombinant rat calbindin D-28k.	No signal in knockout. Mouse knockout: Airaksinen et al. (*Proceedings of the National Academy of Sciences*, 1997, **94**, 1488–1581). Characterization in rat hippocampus: Sloviter (*The Journal of Comparative Neurology*, 1989, **280**, 183–279).
Calretinin	rabbit	Polyclonal, recombinant human calretinin containing a 6-his tagged N-terminus.	Western blot supplied by Swant. No signal in knockout animals; Swant; Schiffmann et al. (*Proceedings of the National Academy of Sciences*, 1999, **96**, 5257–5262).
ErbB4	mouse	Monoclonal, extracellular fragment, recombinant human c-erbB-4/HER-4 oncoprotein.	No signal in knockout. Western blot; band as expected. Cross-species comparisons: Neddens et al. (*Biological Psychiatry*, 2011, **70**, 636–681). Antibody generation: Vullhorst et al. (*The Journal of Neuroscience*, 2009, **29**, 12255–12319), Chen et al. (*Journal of Biological Chemistry*, 1996, **271**, 7620–7629).
GABAAα1	rabbit	Polyclonal, N-terminal aa 1–9 (the extracellular side).	Same epitope, production, and labeling as rabbit GABAAα1 characterized in Baude et al. (*Cerebral Cortex*, 2007, **17**, 2094–2107), including mouse knockout test).
GABAAα1	guinea pig	Fusion protein, amino acids 328–382, mouse α1 subunit.	Western blot; band as expected. Tested in a knockout and in cells transfected with GABAAα1 cDNA. Characterization: Kaufmann et al. (*The Journal of*

			Comparative Neurology, 2009, **515**, 215–245).
Gephyrin	mouse	Monoclonal, N-terminus, rat gephyrin.	Western blot; band at 93 kDa. No Geph7a signal in knockout. Co-purifies with glycine receptor. Mouse knockout: Feng et al. 1998. Antibody generation: Pfeiffer et al. (*Proceedings of the National Academy of Sciences*, 1984, **81**, 7224–7231)..
Gephyrin	mouse	Monoclonal, N-terminus, rat gephyrin.	Same as Synaptic Systems 147 021 but purified IgG.
Hyperpolarization-activated cyclic nucleotide-gated potassium channel 4 (HCN4)	mouse	Monoclonal, fusion protein aa 1019–1108, rat HCN4, cytoplasmic domain.	Western blot, Khurana et al. (*The Journal of Neuroscience*, 2012, **32**, 2814–2823); Western blot and coimmunprecipitation, demonstration of preabsorbtion by HCN4 peptide, Partida et al. (*Investigative Ophthalmology & Visual Science*, 2012, **53**, 1696–1703); same 137kD band western blot as a polyclonal antibody, Stradleigh et al. (*The Journal of Comparative Neurology*, 2011, **519**, 2546–2573).
Kv1.1	mouse	Monoclonal, synthetic peptide aa 191–208, rat Kv1.1, extracellular domain.	No signal in knockout, Lorincz and Nusser (*The Journal of Neuroscience*, 2008, **28**, 14329–14340). Recognizes some somata as well as AISs, Lorincz and Nusser 2008, Campanac et al. (*Neuron*, 2013, **77**, 712–722). Also characterized by NeuroMab.
Metabotropic glutamate receptor 2/3 (mGluR2/3)	guinea pig	Polyclonal, intracellular C-terminal aa 813–872, rat mGluR2.	Recognizes mGluR2 and mGluR3 (transfected cell lines, Western blots, preabsorption). Generation and characterization of rabbit antibody H12: Ohishi et al. (*Neuron*, 1994, **13**, 55–121) and Shigemoto et al. (*The Journal of Neuroscience*, 1997, **17**, 7503–7525).
Metabotropic glutamate receptor type 7b (mGluR7b)	guinea pig	Polyclonal, synthetic peptide, C-terminal, human mGluR7b.	Western blot; 2 bands as expected. Abolished by preadsorption. No cross-reactivity with mGluR7a. Generation and characterization: Shigemoto et al. (*The Journal of Neuroscience*, 1997, **17**, 7503–7525).
Neuronal Ca^{2+}-binding protein 1 (NECAB 1)	mouse	Polyclonal, full-length human NECAB 1.	Same as in mouse. Western blots; as expected, no cross-reactivity with NECABs 2 and 3. Mouse brain, and antibody generation: Sugita et al. (*Neuroscience*,

			2002, **112**, 51–114).	
Neuronal nitrogen oxide synthase (nNOS)	rabbit	Polyclonal, recombinant human nNOS.	Does not cross react with iNOS or eNOS. No signal in knockout for rabbit antibody (Zymed/Invitrogen) of same mass. Mouse knockout and similar rabbit antibody: Gyurko et al. (*Endocrinology*, 2002, **143**, 2767–2841).	
Neuropeptide Y (NPY)	sheep	Polyclonal, synthetic peptide conjugated to bovine thyroglobulin.	Radioimmunoassays with other peptides lacked significant cross-reactivity except peptide YY. Antibody generation: Blessing et al. (*The Journal of Comparative Neurology*, 1986, **248**, 285–585).	b
Neuropeptide Y (NPY)	rabbit	Polyclonal, synthetic porcine NPY conjugated to methylated bovine serum albumin.	No significant cross-reactivity with other related peptides (APP, PYY). Antibody generation and characterization: Allen et al. (*Science*, 1983, **221**, 877–886).	c
Parvalbumin	guinea pig	Polyclonal, full length rat parvalbumin.	Western blot; abolished by pre-absorption with recombinant parvalbumin. Same labeling as Synaptic Systems rabbit antibody 195 002 and Swant monoclonal antibody 235. Rat hippocampus: Kosaka et al. (*Brain Research*, 1987, **419**, 119–149), Sloviter (*The Journal of Comparative Neurology*, 1989, **280**, 183–279). Mouse knockout: Schwaller et al. (*The American Journal of Physiology*, 1999, **276**, 403).	
Parvalbumin	mouse	Monoclonal, carp muscle parvalbumin.	No signal in knockout. Similar to other parvalbumin antibodies. Characterization: Celio et al. (*Cell Calcium*, 1988, **9**, 81–87). Mouse knockout: Schwaller et al. (*The American Journal of Physiology*, 1999, **276**, 403).	
Parvalbumin	rabbit	Polyclonal, purified parvalbumin, rat testis.	No signal in knockout, shown by Swant. Similar to other parvalbumin antibodies. Mouse knockout: Schwaller et al. (*The American Journal of Physiology*, 1999, **276**, 403).	
Parvalbumin	goat	Polyclonal, rat muscle	No signal in knockout, shown by Swant. Similar to	

		parvalbumin.	other parvalbumin antibodies. Mouse knockout: Schwaller et al. (*The American Journal of Physiology*, 1999, **276**, 403).	
PHA-L	goat	Raised to pure lectins in hyperimmunized goats.	Reacts with both Phaseolus vulgaris erythroagglutinin (PHA-E) and leucoagglutinin (PHA-L).	
PHA-L	rabbit	Raised to pure lectins in hyperimmunized goats.	Reacts with both Phaseolus vulgaris erythroagglutinin (PHA-E) and leucoagglutinin (PHA-L).	
PHA-L-biotinylated	goat	Raised to pure lectins in hyperimmunized goats.	Reacts with both Phaseolus vulgaris erythroagglutinin (PHA-E) and leucoagglutinin (PHA-L).	
Pro-cholecystokinin	rabbit	Cysteine-tagged C-terminal aa (CSAEDYEYPS), pro-cholecystokinin coupled to keyhole limpet hemocyanin.	Similar labeling to two non-commercial antibodies characterized by Sloviter and Nilaver (*The Journal of Comparative Neurology*, 1987, **256**, 42–102), Morino et al. (*The European Journal of Neuroscience*, 1994, **6**, 681–773).	
SATB1 (N-14)	goat	Polyclonal, N-terminus, human SATB1.	Similar labeling to rabbit antibody ab70004. Mouse cortex: Huang et al. (*Neuroscience Research*, 2011, **71**, 12–33). Mouse knockout: Balamotis et al. (*Molecular and Cellular Biology*, 2012, **32**, 333–380).	d
SATB1 (N-14)	rabbit	Polyclonal, 18 aa near N-terminus, human SATB1.	No signal in knockout for a similar rabbit antibody. Western blot, different band to SATB2 at mouse P1. Neuron-specificity shown by NeuN colocalization. Original rabbit antibody: Dickinson et al. (*Cell*, 1992, **70**, 631–1276). Mouse cortex: Huang et al. (*Neuroscience Research*, 2011, **71**, 12–33). Mouse knockout: Balamotis et al. (*Molecular and Cellular Biology*, 2012, **32**, 333–380).	e
SATB2	rabbit	Polyclonal, synthetic peptide conjugated to keyhole limpet	Same labeling as a non-commercial specific rabbit antibody that shows no cross-reactivity to SATB1 in mice; Western blot, double immunofluorescence tests.	f

		hemocyanin, aa 700 to C-terminus, mouse SATB2.	Isolation from rat cortex: Szemes et al. (*Neurochemical Research*, 2006, **31**, 237–283). Non-commercial SATB2: Balamotis et al. (*Molecular and Cellular Biology*, 2012, **32**, 333–380). Mouse brain: Britanova et al. *The European Journal of Neuroscience*, 2005, **21**, 658–726).	
SATB2 (SATBA4B10)	mouse	Monoclonal, recombinant fragment C-terminal, human SATB2.	Same CA1 pyramid nuclear immunoreactivity as rabbit antibody ab34735 but with additional labeling as observed for SATB1. Adult mouse brain: Nielsen et al. (*Cerebral Cortex*, 2010, **20**, 1904–1918; Fig. 1e). Mouse knockouts: Britanova et al. (*American Journal of Human Genetics*, 2006, **79**, 668–746), Dobreva et al. (*Cell*, 2006, **125**, 971–1057).	g
Somatostatin (SOM)	mouse	Monoclonal, conjugated to a protein carrier, human somatostatin.	Same labeling as a rat antibody Chemicon MAB354. No signal in preabsorption test for rat antibody. Mouse hippocampus, rat antibody: Jinno and Kosaka (*The Journal of Comparative Neurology*, 2000, **428**, 377–465). Rat antibody test: Kubota et al. (*Cerebral Cortex*, 2011, **21**, 1803–1820).	h
Vasoactive intestinal polypeptide (VIP)	rabbit	Polyclonal, synthetic peptide, full-length mature human VIP conjugated to keyhole limpet haemocyanin.	Similar labeling to 3 other VIP antibodies raised in rabbit against porcine VIP: Sloviter and Nilaver (*The Journal of Comparative Neurology*, 1987, **256**, 42–102).	
Vesicular GABA transporter (VGAT)	guinea pig	Polyclonal, Strep-Tag fusion protein, aa 2–115, rat VGAT (cytoplasmic domain).	Similar to C- and N-terminal fusion protein antibodies. Former gave additional unknown lower mass band in brain extract but same immunoreactivity as specific latter antibody; see rat cortex: Chaudhry et al. (*The Journal of Neuroscience*, 1988, **18**, 9733–9783). Similar rabbit antibody generation: Takamori et al. (*The Journal of Neuroscience*, 2000, **20**, 4904–4915).	
Vesicular GABA transporter	rabbit	Polyclonal, aa 31–112, mouse VGAT	Western blot; band at 57 kDa. Similar to guinea pig antibody. Characterization: Fukudome et al. (*The*	

(VGAT)		(cytoplasmic domain).	*European Journal of Neuroscience*, 2004, **19**, 2682–2774).
Vesicular GABA transporter (VGAT)	rabbit	Polyclonal, synthetic peptide aa 75–87, rat VGAT (cytoplasmic domain) conjugated to keyhole limpet hemocyanin.	Same epitope and production as the specific VGAT/1 antibody by Takamori et al. (*The Journal of Neuroscience*, 2000, **20**, 4904–4915).

Supplementary Table 2. Primary antibodies. Notes: **a**, Observed in axon initial segments in CA3. Additional non-specific labeling occasionally observed in somata of CA3 sPyr. **b**, Weaker immunoreactivity in some interneurons in hippocampal sPyr compared to other NPY antibodies. Weak background in nuclei of neurons in sPyr. **c**, No significant background; strong immunoreactivity observed in subpopulations of hippocampal interneurons including in sPyr. **d**, At 1:100 dilution slight cross-reactivity detected with SATB2 (CA1 pyramidal cell nuclei). Weak immunoreactivity observed in CA4 neuron nuclei. **e**, Observed in hippocampal interneurons and not pyramidal neurons. Some interneurons that show strong immunoreactivity for the goat antibody sc-5989 are weak for the rabbit antibody. **f**, Observed in nuclei of CA1 pyramids and not interneurons. Cross-reactivity with blood vessels. **g**, Immunoreactivity observed in CA1 pyramidal cells and a subpopulation of interneurons, consistent with the combination of specific SATB2 and SATB1 antibodies. **h**, Labels same population of cells as other SOM antibodies but greater signal in dendrites and axon. List of sources: 1, UC Davis/NIH NeuroMab Facility, Davis, CA, USA. www.neuromab.org. 2, StressGen, via Bioquote Limited, York, UK. www.bioquote.com. Currently stocked by Enzo Life Sciences AG, Lausen, Switzerland. www.enzolifesciences.com. 3, Synaptic Systems Gesellschaft für neurobiologische Forschung, Entwicklung und Produktion mbH, Goettingen, Germany. www.sysy.com. 4, Swant, Bellinzona, Switzerland. www.swant.com. 5, Thermo Fisher Scientific, Kalamazoo, MI, USA. www.labvision.com. 6, Kind gift from Prof. W. Sieghart, Brain Research Institute, Vienna, Austria. 7, Kind gift from Prof. R. Shigemoto, Division of Cerebral Structure, National Institute for Physiological Sciences, Okazaki, Japan. 8, Abnova, Taipei City, Taiwan. www.abnova.com. 9, EMD Millipore Corporation, Billerica, MA, USA. www.millipore.com. 10, ImmunoStar, Inc. (DiaSorin), Hudson, WI, USA. www.immunostar.com. 11, Vector Laboratories, Inc., Burlingame, CA, USA. www.vectorlabs.com. 12, Kind gift from Professor M. Watanabe / FRONTIER INSTITUTE Co.Ltd, Hokkaido, Japan. http://www.frontier-institute.com. 13, Santa Cruz Biotechnology, Inc., Santa Cruz, CA, USA. www.scbt.com. 14, Abcam, Cambridge, UK. www.abcam.com. 15, GeneTex, Inc. Irvine, CA, USA. www.genetex.com. 16, MorphoSys UK Ltd t/a AbD Serotec, Oxford, UK. www.abdserotec.com. *Purified by Prof. W. Sieghart, Brain Research Institute, Vienna, Austria.