nature research

Corresponding author(s): Naoki Yamawaki, Gordon Shepherd

Last updated by author(s): Jan 27, 2019

Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see Authors & Referees and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☒	☐	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	The data acquisition software used for photostimulation and electrophysiology, Ephus (version r2.1.0), is freely available online (www.ephus.org). The data acquisition software used for 2-photon microscopy, Nikon NIS-Elements software (version 4.6.0), is commercially available.
Data analysis	Analyses were conducted using standard functions in MATLAB version 8.2 (Mathworks, 2013b, commercially available), Imaris software (version 8.4.1 or 9.1.2, commercially available), and/or NLMorphologyViewer software (version 0 4 0, available for free at http://www.neuronland.org/NL.html)

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Data sets are available upon request.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	No statistical methods were used to pre-determine sample sizes but our sample sizes are similar to those reported in previous publications (Yamawaki and Shepherd, 2015; Yamawaki et al. 2018). The sample sizes are clearly indicated in the figures and associated text.
Data exclusions	No data points were excluded.
Replication	Each results are replicated multiple times with independent samples (for ex vivo electrophysiology, "samples" are cells from slices prepared from same or different mice, and for in vivo electrophysiology or behavioral test, "samples" are mice). Replication attempts were successful in independent samples. Number of replicate (n) performed is reported when statistic is mentioned for each experiment.
Randomization	Mice were randomly assigned to experimental groups.
Blinding	Data collection and analysis were not performed blind to the condition of experiment, except in behavioral studies. Our circuit studies require experimenter to be able to test connection between defined cell-type.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☐	☒ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology
☐	☒ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	anti-PV in mouse (1:4000, Swant Cat# 235, RRID:AB_10000343) anti-CB in rabbit (1:250, Swant Cat# CB38, RRID:AB_2721225) anti-CR in goat (1:4000, Swant Cat# CG1, RRID:AB_10000342) anti-reelin in mouse (1:1000, Millipore Cat# MAB5364, RRID:AB_2179313) anti-NPY in rabbit (1:1000, ImmunoStar Cat# 22940, RRID:AB_2307354) anti-nNOS in rabbit (1:500, Millipore Cat# AB5380, RRID:AB_91824) anti-SOM in rat (1:1000, Millipore Cat# MAB354, RRID:AB_2255365) anti-rabbit n donkey (1:200; Molecular Probes Cat# A-21206, RRID:AB_141708) anti-goat in donkey (1:200; Molecular probe Cat# A-11055, RRID:AB_142672) anti-rat in goat (1:200; Cat# A-11029, RRID:AB_138404) anti-mouse in goat (1:200; Molecular Probes Cat# A-11006, RRID:AB_141373) anti-mCherry in chicken (1:16000, Abcam Cat# ab205402, RRID:AB_2722769) biotinylated anti-chicken IgG (H+L) in goat (1:200, Vector Laboratories Cat# BA-9010, RRID:AB_2336114)
Validation	Some primary antibodies were validated for immunohistochemical use by the manufacturers using knock-out mice: anti-PV (https://www.swant.com/pdfs/Monoclonal_parvalbumin_235.pdf) anti-CB (https://www.swant.com/pdfs/Rabbit_anti_calbindin_D-28k_CB38.pdf) anti-CR (https://www.swant.com/pdfs/Goat_anti_calretinin_CG1.pdf) All primary antobodies listed below were validated for immunohistchemical use in rodent in previously published works: anti-NPY (e.g. Forro et al. 2013, Cerebral Cortex; Katona et al., 2017, Hippocampus) anti-reelin (e.g. Quattrocolo and Maccaferri, 2014, J. Neurosci)

anti-nNOS (e.g. Tricoire et al., 2011, J. Neurosci)
anti-SOM (e.g. Scheuss and Bonhoeffer, 2014, Cerebral Cortex)

Animals and other organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research

Laboratory animals	For wild-type mice (WT) we used C57BL/6 mice. For cell-type-specific expression, we used: Gad2-mCherry mice (RRID:IMSR_JAX:023140) Grp_KH288-Cre mice (RRID:MMRRC_037585-UCD) Gad2-Cre mice (NRRID:IMSR_JAX:010802) Ndnf-Cre mice (RRID:IMSR_JAX:028536). Gad2-mCherry mice were maintained by homozygous breeding. Each Cre-line was back-crossed with C57BL/6 mice for at least 6 generations. Mice were 9-20 weeks old at the time of electrophysiological and behavioral experiment. Both sex was used.
Wild animals	Study did not involve wild animals.
Field-collected samples	Study did not involve animals collected from the field.
Ethics oversight	Northwestern University Animal Care and Use Committee

Note that full information on the approval of the study protocol must also be provided in the manuscript.