nature research

Corresponding author(s): David J. Anderson

Last updated by author(s): 8/31/2020

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	StreamPix 7 for behavior video acquisition, Avisoft-RECORDER USGH for Audio recording, Inscopix data acquisition software for microendoscope recording, Synapse for fiber photometry recording
Data analysis	Python2.7 for Animal pose tracking with custom codes (https://neuroethology.github.io/MARS/), MATLAB 2018b for analyzing behaviors and calcium imaging data, GraphPad Prism 8 and MATLAB 2018b for statistical analyses, Adobe Illustrator Ver.24 for assembling figures, Adobe Premiere Pro Ver.14 for video rendering

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

The data that support the finding of this study are available from the corresponding author 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 statistics were used to determine sample sizes. Sample sizes were determined based on our previous experiments to sufficiently detect meaningful biological differences with good reproducibility (Lee et al., 2014, and Remedios and Kennedy et al., 2017, cited in the manuscript).
Data exclusions	Animals in which the virus injection and/or implantation missed the target brain region were excluded from analysis.
Replication	All the experiments were repeated at least two times with separate cohort of animals, and the reproducibility was confirmed.
Randomization	For functional manipulation experiments, about half of the mice in each cage were randomly assigned to either control or experimental groups. All control mice were treated with the same experimental procedures, except a control virus was injected instead. For imaging experiments, animals were randomly chosen from Esr1-Cre transgenic cohort. The order of male or female intruder experiments were performed in the random order in imaging experiments, but were not randomized in functional manipulation experiments.
Blinding	The experimenter was blind to experimental or control groups during data collection and analyses.

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

Animals and other organisms

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

Laboratory animals	Experiments were performed on male and female C57BL6N and BALB/c mice, between 8 and 24 weeks of age. All mice were housed in ventilated micro-isolator cages in a temperature-controlled environment (median temperature 23 °C, humidity 60%), under a reversed 11 h dark– 13h light cycle, with ad libitum access to food and water. Mouse cages were changed weekly.
Wild animals	The study did not involve wild animals.
Field-collected samples	The study did not involve field-collected samples.
Ethics oversight	All experimental procedures involving the use of live animals or their tissues were carried out in accordance with the NIH guidelines and approved by the Institutional Animal Care and Use Committee and the Institutional Biosafety Committee at the California Institute of Technology.

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