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# 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.

## Statistical parameters

When statistical analyses are reported, confirm that the following items are present in the relevant location (e.g. 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 |
| ☐ | ☒ | An indication of 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<br>*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 statistics 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<br>*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 |
| ☐ | ☒ | Clearly defined error bars<br>*State explicitly what error bars represent (e.g. SD, SE, CI)* |

*Our web collection on statistics for biologists may be useful.*

## Software and code

Policy information about availability of computer code

| | |
|---|---|
| Data collection | Fear conditioning videos recorded with Med Associates Video Freeze (2.7.0.106). Open field recorded with Stoeling ANY-Maze (4.99z). Confocal images collected with Leica LAS (2.7.3.9723) |
| Data analysis | Data analyzed with Image J (1.48v), Stopwatch+ (v1.5.1), Excel (v14.7.2), JMP (v14), and GraphPad Prism (v6) |

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 upon request. 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

All relevant data supporting the findings of this study are available from the corresponding author upon reasonable request.

# Field-specific reporting

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

☒ Life sciences ☐ Behavioural & social sciences

For a reference copy of the document with all sections, see nature.com/authors/policies/ReportingSummary-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 predetermine sample size, but the sample sizes were based on those in previously published studies (Denny et al., 2014 & Ramirez et al., 2013). |
| Data exclusions | A cohort of 6 mice shipped to UT from Columbia and potentially exposed to extreme heat did not extinguish and was removed from further analysis. Five mice were found to have no eYFP expression suggestive of a genotyping error and were removed from further analysis. |
| Replication | All of the experiments, except the Halo-mediated silencing experiments, were replicated at least twice. |
| Randomization | Mice were randomly assigned to groups at the start of each experiment. |
| Blinding | Investigators performed experiments with knowledge of the group allocations. Investigators were blind to the group allocations during cell quantification and behavioral video scoring. |

## Materials & experimental systems

Policy information about availability of materials

| n/a | Involved in the study |
|---|---|
| ☒ | ☐ Unique materials |
| ☐ | ☒ Antibodies |
| ☒ | ☐ Eukaryotic cell lines |
| ☐ | ☒ Research animals |
| ☒ | ☐ Human research participants |

### Antibodies

| | |
|---|---|
| Antibodies used | For Arc or cFos immunohistochemistry:<br>Rabbit anti-Arc primary antibody (Synaptic Systems, 156 003), dilution 1:2000<br>Rabbit anti-cFos primary antibody (Millipore, ABE457), dilution 1:1000<br>Donkey anti-rabbit Cy3 secondary antibody (Jackson ImmunoResearch Labs, 711-165-152), dilution 1:500<br><br>For eYFP immunohistochemistry:<br>Chicken anti-GFP (Abcam, ab13970), dilution 1:500<br>Biotin donkey anti-chicken secondary antibody (Jackson ImmunoResearch Labs, 703-065-155), dilution 1:500<br>Cy2-conjugated streptavidin (Jackson ImmunoResearch Labs, 016-220-084), dilution 1:250 |
| Validation | Antibodies were first validated before use. Primary antibody was tested in different dilutions on sample mouse tissue to determine optimal primary antibody concentration. Similar immunohistochemistry reagents and protocols were used in previously published reports (Denny et al., 2014; Cazzulino et al., 2016). |

### Research animals

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

| | |
|---|---|
| Animals/animal-derived materials | Male and female ArcCreERT2 mice, Halo-eYFPflx mice (Ai39), and ChR2-eYFPflx mice (Ai32) aged two-seven months used in all experiments. |

# Method-specific reporting

| n/a | Involved in the study |
|---|---|
| ☒ | ☐ ChIP-seq |
| ☒ | ☐ Flow cytometry |
| ☒ | ☐ Magnetic resonance imaging |