nature portfolio

Corresponding author(s): Kay M. Tye and Cewu Lu

Last updated by author(s): Nov 13, 2021

Reporting Summary

Nature Portfolio 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 Portfolio policies, see our Editorial Policies 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	All data were collected with commercially available software reported in the methods. More information is available upon request.
Data analysis	Data were analyzed with commercially available, open-source and custom made code. Descriptions of these analyses are found in the methods. In cases that there are published descriptions of the methods, full references are included. AlphaTracker software is available on github and other custom code is available upon request.

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 and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio 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 description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

The datasets generated during and/or analyzed during the current study will be made available upon reasonable 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	Sample sizes were not predetermined and based on similar studies in the literature (Wang et al., 2011; Zhou et al., 2017). Sample size is reported in the legends and methods.
Data exclusions	Subjects with mistargeted viral injections were excluded from analyses. Animals with electrodes that did not had any cells were used as competitors in competition sessions. Electrophysiology recording sessions in which there was battery failures in the recording devices were excluded from the study.
Replication	Our behavioral assay was piloted in a separate group of mice that was not included on this study. In both the pilot and the study we see the same behavioral effects of relative social rank. Our optogenetic experiments were ran in two cohorts and in both we saw the same effect. Many of our neurophysiological findings replicate across different groups of relative rank: using all mice across all ranks, restricting it to intermediate ranks, and looking at just absolute rank 1 vs rank 4 animals.
Randomization	For optogenetic manipulation experiments the cage assignment to control or experimental group was randomized. For behavioral competition experiments and tube testing the order of the competitions was randomized. Given that control recordings with the animals alone were done in the same arena as the competition, all the recording alone controls happened before the competition recordings to avoid context associations of previous competitions during the control recordings. Animals were determined to be relative dominant vs subordinates based on the ranks determined by the tube test which occurred in a randomized order daily for the duration of the experiment.
Blinding	During behavioral testing investigators were not always blind to the animal's ranks given familiarity with the subjects. However, for behavioral scoring the experimenters were blinded to the animal's ranks. For optogenetic experiments the experimenters were blinded to the group assignment of the animals (eYFP vs ChR2). During electrophysiological data processing and analysis experimenters were blinded to the animal's ranks until the point that all data was processed such that group comparisons could be made.

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 and archaeology
☐	☒ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

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	Group housed male mice of C57 strain, between the ages of 8-20 weeks were used for all the experiments.
Wild animals	No wild animals were used in this study
Field-collected samples	No field-collected samples were used in this study
Ethics oversight	IACUC Salk Institute for Biological studies and MIT

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