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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.

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	In forced swimming test assays mouse movements were tracked using an open source Behavioral Monitoring Tool, which can be found at http://ratmonitoring.sourceforge.net. In the social preference assays, the mice movements were tracked by an open source ToxTrac, which can be found at https://sourceforge.net/p/toxtrac/wiki/Home/.
Data analysis	For the forced swimming test and social preference assays, the analyses were conducted using custom scripts written in Mathematica (11.3 Wolfram) software. All codes are 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/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

All datasets generated during this study and the analysis scripts 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	For in vitro microscopy imaging experiments, 3-5 videos were imaged to inspect >100 cells per experimental condition; for the c-fos immunohistological experiments, 3-5 mice were injected and their tissue imaged per experimental condition; for the fiber photometry experiments, 3 mice were used per experimental group; for the forced swimming test assays, total of 40 mice were injected and tested in the behavior experiments; for the social preference assays, total of 39 mice were injected and tested in the behavior experiments. Sample sizes for behavioral experiments were informed by the number of subjects reported for similar studies, based on the minimal number of mice required to detect significance with an alpha rate set at .05 in a standard power experiment.
Data exclusions	Imaged neurons were excluded based on the expression level (i.e. no detectable expression) of the designed receptors (hM3Dq-mcherry or mcherry). Trials in forced swimming tests were excluded based on the identification of adaption in tests. The mouse mobility datasets were automatically selected without bias via the scripts to identify adaptation behavior in trials. The scripts fit the mobility datasets with a linear combination of Gaussian distributions, and the subjects classified as belonging to a mobility distribution centered around 0% prior to exposure to magnetic field were considered to have adapted and were used in analyses. The algorithm and adaptation identification are described in the manuscript. No mice nor trials were excluded from the social preference assays.
Replication	Each in vitro experiment was repeated in 3-5 times per experimental condition. Each in vivo experiment was repeated in 3-10 subjects per experiment. All results in the paper are drawn from the analysis of multiple animals, all numbers are indicated in text and figure captions. In the forced swimming tests and social preference assays, the same cohort of mice were subjected to the behavioral paradigms for 3 consecutive days.
Randomization	Cultured cells were randomly and automatically chosen for each experimental paradigm, Animals were assigned randomly to each experimental group.
Blinding	The investigators were not blinded during in vitro stimulation nor behavior data collection. A separate naive group of blinded investigators conducted data analysis.

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	Primary antibodies: Rabbit anti-cfos (Cell Signaling technology, 2250s), Goat anti-GFAP (Abcam, ab53554), Goat anti-Iba1 (Abcam, ab107159), Cleaved Caspase-3 (Cell Signaling technology, 9661s) Secondary antibodies: Donkey anti-Rabbit, Alexa Fluor 488 (Invitrogen, A-21206), Donkey anti-Goat, Alexa Fluor 488 (Invitrogen, A-11055)
Validation	The antibodies were validated in literature and in our laboratory for immunohistological staining on mouse brain slices (adult, C57BL/6).

Eukaryotic cell lines

Policy information about cell lines

Cell line source(s)	The HEK 293FT cell line was a gift by Feng Zhang (MIT)
Authentication	Microscopic inspection
Mycoplasma contamination	The cell line is negative for mycoplasma contamination
Commonly misidentified lines (See ICLAC register)	N/A

Animals and other organisms

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

Laboratory animals	Adult male C57BL/6 mice (Jackson Laboratory) aged 8 weeks were used in the experiments.
Wild animals	N/A
Field-collected samples	N/A
Ethics oversight	All experimental procedures were approved by the MIT Committee on Animal Care

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