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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	No software was used for data collection
Data analysis	R, R studio, Seurat, Graphpad Prism, ImageJ. R scripts for generating Dimplot and Dotplot are available on github: https://github.com/pangyentseng/NCOMMS-26-032723-T

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

Geo accession code provided.

Research involving human participants, their data, or biological material

Policy information about studies with human participants or human data. See also policy information about sex, gender (identity/presentation), and sexual orientation and race, ethnicity and racism.

Reporting on sex and gender	na
Reporting on race, ethnicity, or other socially relevant groupings	na
Population characteristics	na
Recruitment	na
Ethics oversight	na

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

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, eg., Nat Neurosci. 2023 Apr;26(4):594-605; Sci Transl Med. 2021 Nov 10;13(619):eabe3037
Data exclusions	Mice in which injection was not successful, as judged by reporter staining in the appropriate location, were excluded from analysis of behavioral results. Also, data were excluded for animals that were not fully tested and removed from the study because of veterinarian advised health concerns. Both criterion were pre-established.
Replication	Results from repeated experiments are all included in the experimental findings of the manuscript. The results of these replicates reproduced initial experiments and were combined. For histology, repeats are noted in the figure legends.
Randomization	The order for testing animals was randomized.
Blinding	Mouse behavioral assessments were conducted under blinded conditions. However, other experiments, such as RNA-sequencing analysis, in situ hybridization, immunohistochemistry, and histology, were not conducted under blinded condition.

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
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

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

Antibodies

Antibodies used	Primary antibodies: anti-cFos (rabbit monoclonal, Cell Signaling, catalog # 2250 clone 9F6);
Validation	https://media.cellsignal.com/pdf/2250.pdf

Animals and other research organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research, and Sex and Gender in Research

Laboratory animals	Animals of both sexes with the age of 8-16 weeks were used in experiments. Following the Guide, temperature was maintained between 26-30 degrees Celsius and humidity was maintained between 30-70%. Animals were randomly allocated to the different experimental conditions reported in this study.
Wild animals	na
Reporting on sex	Both male and female mice were included in the study, and animal sex was recorded and balanced across treatment groups. The objective of this work was to evaluate the primary effect of sneezing, not to test sex-specific biological responses. There is no strong evidence of sex-dependent effects for this phenotype. The study was powered to detect the main treatment effect rather than interactions by sex. To minimize unnecessary animal use in accordance with the 3Rs principles, sex was controlled as a biological variable during randomization and housing, but sex-difference testing was not designated as a primary endpoint.
Field-collected samples	na
Ethics oversight	All experiments using mice followed NIH guidelines and were approved by the National Institute of Dental and Craniofacial Research or University of Maryland Baltimore IACUC.

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

Plants

Seed stocks	na
Novel plant genotypes	na
Authentication	na