

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 (<i>n</i>) 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 <i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>
☐	☒ 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. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted <i>Give P values as exact values whenever suitable.</i>
☒	☐ 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 <i>d</i> , Pearson's <i>r</i>), 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	Custom code based on Anaconda in Windows 10. Python==3.7 PySpin wheel==spinnaker_python-2.3.0.77-cp37-cp37m-win_amd64.whl opencv-python (default version) spyder (default version)
Data analysis	SBeA (https://github.com/YNCris/SBeA_release). SBeA_tracker (https://github.com/YNCris/SBeA_release/tree/main/SBeA_tracker/SBeA-Windows-main). SBeA_mapper (https://github.com/YNCris/SBeA_release/tree/main/SBeA_mapper). Dependency softwares of SBeA_tracker: Anaconda and Visual Studio. Dependency packages of SBeA_tracker: (https://github.com/YNCris/SBeA_release/blob/main/SBeA_tracker/SBeA-Windows-main/environment.yml , and https://github.com/YNCris/SBeA_release/blob/main/SBeA_tracker/SBeA-Windows-main/setup.py). Dependency software of SBeA_mapper: MATLAB R2022b Dependency packages of SBeA_mapper: (https://behavioratlas.tech/).

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](#)

Data links can be found at https://figshare.com/projects/Social_behavior_atlas/162718.

The description of data is at https://figshare.com/articles/dataset/SBeA_Readme/22315000.

Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender

Population characteristics

Recruitment

Ethics oversight

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](https://www.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

Data exclusions

Replication

Randomization

Blinding

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

Methods

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

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

- 32 adult male C57BL/6 mice (7–12 weeks old) are used for the free-social behavior test. The mice were housed at 4–5 mice per cage under a 12-h light–dark cycle at 22–25°C with 40–70% humidity, and were allowed to access water and food ad libitum (Shenzhen Institutes of Advanced Technology, Shenzhen, China).
- 5 adult (8 weeks old) Shank3B knockout (KO; Shank3B^{-/-}) mice on C57BL/6J genetic background and 5 adult (8 weeks old) male C57BL/6 mice, were used in the behavioral experiments. Shank3B^{-/-} mice were obtained from the Jackson Laboratory (Jax No. 017688). The mice were housed at 4–5 mice per cage under a 12-h light–dark cycle at 22–25°C with 40–70% humidity, and were allowed to access water and food ad libitum (Shenzhen Institutes of Advanced Technology, Shenzhen, China).
- One male and one female Melopsittacus Undulatus (about 26 weeks old) are used in this study. They are housed in a conventional environment with feed regularly (Shenzhen Institutes of Advanced Technology, Shenzhen, China).
- Two female Belgian Malinois (13 weeks old) are used in this study. They are housed in Kunming Police Dog Base of the Chinese Ministry of Public Security, Kunming, 650204, China, and their behavior test of them is finished in the State Key Laboratory of Genetic Resources and Evolution, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, 650223, China. The dogs are first put into a 2 × 2 m² open field made by fences one by one for the identity recording.

Wild animals

No wild animals were used in this study.

Reporting on sex

- Only male mice are used in this study for the comparable results of previous studies (Huang et al., A hierarchical 3D-motion learning framework for animal spontaneous behavior mapping, Nature Communications, 2021. Peca et al., Shank3 mutant mice display autistic-like behaviours and striatal dysfunction, Nature, 2011), but this study do not focus on sex differences.
- One male and one female Melopsittacus Undulatus (about 26 weeks old) are used in this study. Two female Belgian Malinois are used in this study. We provide the sex of these animals, but the gender settings of them are not considered in experimental design.

Field-collected samples

No field-collected samples were used in this study.

Ethics oversight

All husbandry and experimental procedures of mice and birds in this study were approved by Animal Care and Use Committees at the Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences. And all husbandry and experimental procedures of dogs in this study were approved by Animal Care and Use Committees at the Kunming Institute of Zoology, Chinese Academy of Sciences.

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