

Reporting Summary

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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	LabView (National Instruments); Python (v3.0; Python Software Foundation); Visual Stimulation (v2.0; SENS Software); Imaging (v2.0; SENS Software); SpaSM toolbox (v3.0; Open Software); LinLab2 (Scientifica); MC700B Commander (Molecular Devices); SPOT imaging software (SPOT Imaging Solutions); ggplot2 (ggplot2_3.4.2).
Data analysis	MATLAB 2017b (MathWorks); R (R4.2.1); Seurat packages (Seurat_4.3.0.1); MouseAC_metafile.csv (Yan et al (2020), https://www.jneurosci.org/content/40/27/5177); Custom scripts are available at GitHub: https://github.com/AkiatNIG/Matsumoto_et_al_GABA2024 .

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 relevant data are available in the Supplementary Information/Source Data file and from the GitHub: https://github.com/AkiatNIG/Matsumoto_et_al_GABA2024.

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 [Not applicable](#)

Reporting on race, ethnicity, or other socially relevant groupings [Not applicable](#)

Population characteristics [Not applicable](#)

Recruitment [Not applicable](#)

Ethics oversight [Not applicable](#)

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 No statistical tests were performed to predetermine sample size, but the sample sizes in this study were similar or larger than those in previous publications (Chen et al., 2014; Park et al., 2014; Sethuramanujam et al., 2021; Yonehara et al., 2013).

Data exclusions For clustering analysis, ROIs which did not show significant responses to visual stimuli were excluded. The procedure was described in the Methods. After the stage, no data were excluded.

Replication All experiments were replicated more than three times independently. Our experimental results and analysis were consistent across animals, retinal locations, ages, and either sexes (Supplementary Figure 3).

Randomization For all experiments, mice were randomly allocated. Experimenters were blind for the sex.

Blinding Imaging data analysis and clustering analysis were performed blind to the experiment 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

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

We used 8- to 16-week-old mice of either sex. Mice were group-housed throughout and maintained in a 12-hour/12-hour light/dark cycle with ad libitum access to food and water. The temperature (20-25 °C) and humidity were controlled (45-65%) in the animal rooms. Mouse: C57BL/6J (Janvier Labs); Mouse: ChAT-IRES-Cre (strain: ChATm2(cre)Lowl/MwarJ (Jackson laboratory); Mouse: ROSA26-STOP-tdTomato (Gt(ROSA)26Sortm9(CAG-tdTomato)Hze/J (Jackson laboratory); Mouse: OxtR-T2A-Cre (strain: Cg-Oxtrtm1.1(cre)Hze/J (Jackson laboratory)

Wild animals

No wild animals were used.

Reporting on sex

We used mice of either sex.

Field-collected samples

No field-collected samples were used.

Ethics oversight

All animal experiments were performed according to standard ethical guidelines and were approved by the Danish National Animal Experiment Committee (Permission No. 2015-15-0201-00541 and 2020-15-0201-00452) and National Institute of Genetics (R-23).

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

Plants

Seed stocks

Not applicable to this study.

Novel plant genotypes

Not applicable to this study.

Authentication

Not applicable to this study.