nature portfolio

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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	At the Ruber Hospital Internacional, Madrid, ongoing intracranial EEG (iEEG) activity was acquired using an XLTEK EMU128FS amplifier (XLTEK, Oakville, Ontario, Canada). Intracranial data in Zurich were acquired with a Neuralynx ATLAS system.
Data analysis	Custom code written in MATLAB version R2019b (the Mathworks, Natick, MA, USA) and Fieldtrip functions (https://www.fieldtriptoolbox.org) were used to analyze all data. Custom functions included in the utils folder https://drive.upm.es/s/qq9kpFKmrdzAT9k?dir=/utils/functions. Analysis codes are available in the AversiveMemRetrieval GitHub repository under the following link: https://github.com/mnlcosta/AversiveMemoryRetrieval, and have been archived on Zenodo with the following DOI: 10.5281/zenodo.15736783.

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 electrophysiological data generated in this study have been deposited in UPM Drive under the following link: https://drive.upm.es/s/qq9kpFKmrdzAT9k. The

raw patient data are protected and not available due to data privacy regulations and the conditions of ethical approval. Additional processed data supporting the findings of this study are available at the same link. Further information can be obtained by contacting the lead author.

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	In the current dataset, 23 subjects (12 females and 11 males) participated in the study, age 18–59 years. Findings apply to both sexes.
Reporting on race, ethnicity, or other socially relevant groupings	Race and ethnicity were not recorded, as these variables were not relevant to the aims or analyses of this study. Participants were included based solely on clinical criteria related to epilepsy monitoring. The dataset included 23 patients (12 female) with refractory focal epilepsy who had depth electrodes implanted for diagnostic purposes (Supplementary Table 1). Sixteen participants were recorded at Hospital Ruber Internacional, Madrid (Spain), and seven at the Swiss Epilepsy Center, Zurich (Switzerland). No analyses were performed to compare subgroups across recording sites.
Population characteristics	See above
Recruitment	We included in the study all patients that accepted to participate in the study and that had electrodes implantation in the amygdala and/or hippocampus. Implantation sites were chosen solely on the basis of clinical criteria.
Ethics oversight	All participants signed informed consent. The study received full approval from the local ethics committees of the Hospital Ruber Internacional, Madrid, Spain and Kantonale Ethikkommission, Zurich, Switzerland (PB-2016-02055).

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 larger or equal to those reported in previous publications (Zheng et al., Nature Communications 2017; Mendez-Bertolo et al., Nature Neuroscience 2016). Results of encoding related responses of 18 of the 23 participants presented here have been previously reported in (Costa, Lozano et al., Nature Communications 2022).
Data exclusions	In the current dataset 23 patients (Supplementary Table 1) with refractory focal epilepsy (12 female) participated, with depth electrodes implanted only for diagnostic purposes. All participants had electrodes in the amygdala and 14 also in the ipsilateral hippocampus. Three participants were subjected to exclusion from the electrophysiological analysis on the grounds of insufficient signal quality.
Replication	All analyses were conducted using custom-written scripts made publicly available in a GitHub repository to allow full reproducibility. Key findings were replicated across independent subsets of participants. The consistency of results across patients supports the robustness of the findings.
Randomization	All participants completed the same experimental task; no allocation to separate groups was involved.
Blinding	All participants completed the same experimental task; no allocation to separate groups was involved, making group-level blinding not applicable. However, preprocessing and statistical analyses were performed using standardized pipelines applied uniformly across participants, ensuring blinding at the analysis stage.

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
[x]	[ ] Antibodies
[x]	[ ] Eukaryotic cell lines
[x]	[ ] Palaeontology and archaeology
[x]	[ ] Animals and other organisms
[x]	[ ] Clinical data
[x]	[ ] Dual use research of concern
[x]	[ ] Plants

Methods

n/a	Involved in the study
[x]	[ ] ChIP-seq
[x]	[ ] Flow cytometry
[ ]	[x] MRI-based neuroimaging

Plants

Seed stocks — *Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.*

Novel plant genotypes — *Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.*

Authentication — *Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosiacism, off-target gene editing) were examined.*

Magnetic resonance imaging

Experimental design

Design type	Clinical protocol for structural scanning
Design specifications	N/A
Behavioral performance measures	N/A

Acquisition

Imaging type(s)	structural MRI, CT
Field strength	MRIs were acquired on a 3T
Sequence & imaging parameters	T1-weighted MRI
Area of acquisition	whole brain scanning

Diffusion MRI [ ] Used [x] Not used

Preprocessing

Preprocessing software	SPM8 (http://www.fil.ion.ucl.ac.uk/spm).
Normalization	Data were normalized to MNI space
Normalization template	MNI
Noise and artifact removal	For each patient, the post-electrode placement CTs (post-CT) was co-registered to the pre-electrode placement T1-weighted magnetic resonance images (pre-MRI). To optimize co-registration, both brain images were first skull-stripped. For CTs this was done by filtering out all voxels with signal intensities between 100 and 1300 HU.
Volume censoring	N/A

Statistical modeling & inference

Model type and settings	N/A
Effect(s) tested	N/A

Specify type of analysis: ☐ Whole brain ☐ ROI-based ☐ Both

Statistic type for inference (See Eklund et al. 2016)

N/A

Correction

N/A

Models & analysis

n/a	Involved in the study
✘	☐ Functional and/or effective connectivity
✘	☐ Graph analysis
✘	☐ Multivariate modeling or predictive analysis