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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	Intracranial EEG signals were recorded using one of two amplifier types (dictated by clinical location during acquisition): (1) NicoletOne amplifier (Natus Neurologics, Middleton, WI), with signals bandpass filtered from 0.16 to 250 Hz and digitized at 512 Hz; (2) Neuroworks Quantum Amplifier (Natus Biomedical, Appleton, WI), with signals recorded at a sampling rate of 2048 Hz, bandpass filtered between 0.01 to 682.67 Hz and then decimated to 512 Hz.
Data analysis	The FLM movie was analyzed and parsed using the Praat software (https://www.fon.hum.uva.nl/praat/) and FFmpeg toolbox (https://www.ffmpeg.org/). The iEEG signals were analyzed with Matlab (R2021a), where encoding modeling analyses were conducted using mTRF toolbox (https://github.com/mickcrosse/mTRF-Toolbox). Audiovisual feature extraction was implemented in Python (3.10), where librosa (https://librosa.org/), pymoten (https://github.com/gallantlab/pymoten), and pytorch (2.1.0) were applied for different features (see Methods section for details).

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 custom code and anonymized sample data have been deposited in https://github.com/flinkerlab/audiovisual_frontal_organization.

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 movie-watching task, 19 patients undergoing neurosurgical evaluation for refractory epilepsy participated (12 females, gender assigned based on medical record). In the online movie-rating task, 26 crowdsourced raters were included (11 females, gender identified by self-report). Given the comparable numbers of male and female participants in both groups, we believe our findings are applicable across genders.
Reporting on race, ethnicity, or other socially relevant groupings	All 19 epilepsy patients were native English speakers. Among the 26 raters, 23 were native English speakers, and 3 self-identified as Indian and reported being proficient in English. All raters were randomly recruited through the Amazon MTurk platform.
Population characteristics	The first cohort consisted of 19 patients undergoing neurosurgical evaluation for refractory epilepsy (12 females; all right-handed; 32.053 ± 11.297 years old). The second cohort consisted of 26 crowdsourced raters who participated in an online movie-rating task (11 females; 3 left-handed; 42.154 ± 8.694 years old).
Recruitment	The patients were recruited from NYU Langone Hospital via informed consent prior to their neurosurgical procedures or upon admission to the hospital unit for evaluation. The raters were randomly recruited through the Amazon MTurk platform.
Ethics oversight	The current study protocol was approved by the NYU Langone Medical Center Committee on Human Research.

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	The sample size for the iEEG experiments was not predetermined due to the practical constraints of bedside recordings in a hospital setting. However, the resulting electrode coverage across all included patients indicates that we have sufficient spatial sampling to examine the overall patterns of audiovisual processing during movie viewing. The sample size for the online movie-rating task was determined a priori to achieve a statistical power of 0.8.
Data exclusions	Electrodes within the seizure onset zone (SOZ), or showing epileptiform activity, line noise artifacts, or large amplitude shifts were excluded.
Replication	We applied multiple approaches to verify the robustness of our main findings, including unsupervised methods such as NMF and supervised methods such as mTRF modeling. We conducted the encoding analysis on all electrodes, rather than only on the active electrodes that survived the permutation test, thereby avoiding potential double-dipping problem.
Randomization	No experimental groups were assigned, as this study employed a within-subject design.
Blinding	Participants were not informed of the study's objectives. Investigator blinding was not applicable as the current study did not involve a between-subjects design.

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

Plants

Seed stocks	n/a
Novel plant genotypes	n/a
Authentication	n/a