

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	Stimuli were generated using MATLAB (r2016b; MathWorks) and Psychtoolbox routines. EEG activity was recorded using a g.Tech g.Nutilus Multi-Purpose system with 30 active electrodes.
Data analysis	EEG data were processed in MATLAB (R2013b), using functions from the EEGLAB toolbox, Fieldtrip and custom scripts. Representational Similarity Analysis was performed using the CoSMoMVPA toolbox. Multivariate pattern analysis (MVPA) was conducted using the MVPA-Light toolbox.

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 and codes will be shared on a public repository upon acceptance.

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	A formal sex- and gender-based analysis was not conducted in this study. This decision was based on the fact that prior foundational studies in this research domain have not incorporated sex- or gender-specific stratification.
Reporting on race, ethnicity, or other socially relevant groupings	No socially relevant grouping variables were collected in the dataset; therefore, subgroup analyses were not feasible.
Population characteristics	None of these participant characteristics were collected.
Recruitment	Participants were recruited on a voluntary basis through flyers and social media.
Ethics oversight	Written informed consent was obtained from all participants, and the study was conducted in accordance with the ethical guidelines of the Commission for Research Ethics at the University of Florence (protocol no. 174, September 23, 2021), and the Declaration of Helsinki.

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

Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	This study employed a quantitative experimental design to investigate the relationship between EEG signals and visual perception. Data collected were exclusively quantitative, including electrophysiological (EEG) measures and behavioral perceptual responses. The experiment followed a repeated-measures design, with all participants completing all experimental conditions, allowing within-subject comparisons across conditions.
Research sample	Participants were recruited primarily among university students. The resulting sample can be considered broadly representative of the university student population in Florence. No targeted clinical or demographic subgroups were specifically selected beyond general eligibility criteria (having normal or corrected-to-normal vision and being naive to the purpose of the study). Twenty-three adult volunteers (4 men, 19 women; mean $\pm$ SD age: 24 $\pm$ 5) took part in the study. The sample size was based on previous EEG studies investigating similar phenomena, using comparable methodologies.
Sampling strategy	A convenience sampling strategy was employed, recruiting participants primarily through flyers and social media posts. This approach allowed easy access to participants, mainly university students, without randomization or stratification.
Data collection	EEG data were recorded while visual stimuli were presented on a AOC Gaming 27G2U/BK monitor (1920 $\times$ 1080 pixels), positioned 57 cm from the participant in a quiet, darkened room. Researchers were not blinded to the study hypotheses or the total number of experimental conditions. However, experimental conditions were randomized and intermingled across trials, such that the researcher could not determine which specific condition was being administered at any given time.
Timing	Data collection started in June 2023 and ended in July 2024.
Data exclusions	Four participants were excluded due to technical issues during EEG recording, as specified in the Method section.
Non-participation	No participants dropped.
Randomization	The order of stimulus and condition presentation was randomized for each participant.

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

Not applicable.

Novel plant genotypes

Not applicable.

Authentication

Not applicable.