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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	Diverse experiments, primarily implemented in MATLAB with Psychtoolbox
Data analysis	Custom functional connectivity code (publicly released) and mass univariate analyses in SPM 12 (release 7487) and CONN EvLab module (release 19b). General purpose parcellation code: https://github.com/coryshain/parcellate. Scripts to reproduce specific analyses in this study: https://github.com/coryshain/langlocFC.

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

All data and metadata are available on Open Neuro (https://openneuro.org/datasets/ds006071/versions/1.0.0). The dataset is large (many TB) and currently still being uploaded, but it will be fully available prior to publication. We do not have participants' consent to release the full timecourses from which the parcellations were computed, but we are releasing all results from our parcellation procedure and subsequent analyses.

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	Gender information was provided by self-report. Sex and gender were not used in either the selection of participants or the analysis of data, due to lack of strong prior reason to expect sex differences in language processing.
Reporting on race, ethnicity, or other socially relevant groupings	Not collected
Population characteristics	Participants consisted of a representative sample (in terms of race and gender) of neuroanatomically typical English-speaking adults from the MIT community and broader Boston area. The self-reported gender distribution of our final sample was 1,120 female, 836 male, and 1 not reported. Participant age at acquisition time spanned 17-85 years, mean 26.9 years +/- 10.4 (SD).
Recruitment	Recruited primarily by word of mouth and email listservs from the MIT community and broader Boston area. The resulting sample is therefore biased toward populations who are motivated to participate in neuroimaging research, able to do so feasibly, educated, and physically close to MIT. We see no a priori reason to expect any of these biases to have impacted results or to fail to generalize to our species as a whole, but without a more culturally, socioeconomically, and geographically diverse sample, we cannot rule out any such influences.
Ethics oversight	MIT's Committee on the Use of Humans as Experimental Subjects

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	1,199 participants, 1,957 fMRI scanning sessions. The sample was a convenience sample defined as all admissible data collected by the Fedorenko lab between its start (2007) and the time of analysis (2024). Exclusion criteria were minimal and are provided in the manuscript. This sample size makes our study by far the largest of its kind to-date, which we believe makes it sufficient to test the generality of our key claim about the structure and function of the language network.
Data exclusions	Missing or corrupt data, or data that lack functional runs after removing the language localizer task (see manuscript for justification).
Replication	This study is an analysis of a large sample of data previously collected for other studies. We have ensured that the analyses are reproducible from our publicly-released data and code. Although the data took years to collect and full replication is infeasible, we have ensured the generalizability of claims in several ways. First, we held out a key functional contrast (sentences vs. nonwords localizer), building a within-participants replication into the analysis design. Second, we verified that key findings converge across diverse independent analyses (e.g., that different localizers for a given putative contrast replicate the connectivity results, and that connectivity replicates prior task-based localization results). Third, we included citations showing that our results replicate prior claims about the structure and function of the language network in the functional connectome, including Braga et al. 2020; Du et al. 2024, and Du et al. 2025.
Randomization	The dataset comprises a huge number of tasks, but the vast majority of these only involved within- (rather than between-)participant comparisons.
Blinding	Blinding is not relevant because our study does not involve between-group comparisons.

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

Magnetic resonance imaging

Experimental design

Design type: Diverse experiment designs, described in the manuscript and in the publicly available supplementary data

Design specifications: Variable, described in the manuscript and in the publicly available supplementary data

Behavioral performance measures: N/A

Acquisition

Imaging type(s): functional

Field strength: 3T

Sequence & imaging parameters: Variable, described in the manuscript and in the publicly available supplementary data.

Area of acquisition: whole brain

Diffusion MRI: ☐ Used ☒ Not used

Preprocessing

Preprocessing software: SPM, CONN

Normalization: linear spatial normalization

Normalization template: MNI IXI549Space

Noise and artifact removal: BOLD signal in each voxel of each run was denoised by residualizing against variables controlling for the effect of slow linear drifts, subject-motion parameters, signals originating in white matter and cerebrospinal fluid, and potential outlier scans.

Volume censoring: N/A

Statistical modeling & inference

Model type and settings: Custom toolkit (publicly released) for functional connectivity-based network parcellation. Mass univariate analyses (SPM12) of task effects.

Effect(s) tested: High-level descriptions of the critical tasks used in this study are as follows (readers are referred to the citations for additional motivation and methods detail).

Language (reading)
Participants read sequences presented one word at a time on a screen in two conditions: a sentences condition in which the sequence formed a meaningful sentence, and a perceptually matched nonwords condition in which the sequence formed a list of pronounceable pseudowords (30).

Language (Listening)
Participants listened to audio recordings in two conditions: intelligible speech in a familiar language, and unintelligible degraded versions of these recordings (37).

Theory of Mind (Verbal)
Participants read vignettes presented one at a time in two conditions: a false belief condition and a false photo condition (81). The false belief items described a scenario in which a character has a false belief. The false photo items described previous states of the world that are no longer true (e.g., an object that has since been removed). Although careful attention was paid in the design of these items to match the conditions on multiple linguistic dimensions, subsequent work has found that the false belief items are higher in multiple measures of linguistic complexity that are known to modulate language regions, and thus that language network responses to this task do not necessarily reflect theory of mind processing (74).

Theory of Mind (Nonverbal)
Participants viewed a silent animated film (the Pixar short Partly Cloudy) which has been proposed as a naturalistic theory of mind localizer (138). The film was coded for time intervals that depict (a) mental state content, (b) physical events, (c) non-mentalizing social interactions, and (d) characters experiencing physical pain, and these interval codes were used as regressors to estimate the critical task contrast (response to mental segments over physical segments).

Executive (Working Memory)
Participants viewed sequences of marked squares on a grid and were tasked with keeping track of all marked locations, assessed at the end of the sequence using a two-alternative forced choice (84). Items occurred in two conditions: easy (4 locations) and hard (8 locations).

Numerical (Math)
Participants saw a number and were tasked with computing its cumulative sum with a sequence of three additional numbers (84). The addends occurred in two conditions: easy (magnitude 2-4) and hard (magnitude 6-8).

Music
Participants listened to tonal melodies in two conditions, an intact condition in which the melody followed typical Western tone sequences and rhythm, and a scrambled condition in which these melodies' tones and rhythms were randomly scrambled (98).

High-Level Visual Perception
Participants viewed 3-second silent video clips in 5 conditions: faces, body parts, objects, scenes, and randomly scrambled objects (139).

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

Functional and/or effective connectivity: Pearson correlation