

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

Shure SM10ACN Cardioid Dynamic head-worn microphone
Tascam DR-10L Digital Audio Recorder
CTF 275-channel axial gradiometer MEG system (Port Coquitlam, British Columbia, Canada)
Polhemus Fasttrack 3D Digitizer

Data analysis

Audio-Tokens Toolbox
Python-parselmouth
Brainstorm (March 2021 distribution)
Custom Matlab code (https://github.com/aiwiesman/QPN_SpeechAnalysis; <https://github.com/nichrishayes/ArtifactScanTool>)
R (version 4.0.3)
SPM12

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 used in the preparation of this work are available from the QPN through the Clinical Biospecimen Imaging and Genetic (C-BIG) repository (<https://www.mcgill.ca/neuro/open-science/c-big-repository>), the PREVENT-AD open resource (<https://openpreventad.loris.ca/>), and the OMEGA repository (<https://www.mcgill.ca/bic/resources/omega>).

Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender	Sex was based on self-reporting and was matched across the participant groups. No analyses concerning sex were performed, as this variable was not considered relevant to the experimental hypotheses.
Population characteristics	The study sample consisted of 59 patients with mild-to-moderate Parkinson's disease and 65 older adults who were matched on age, self-reported sex, handedness, and highest level of education. All participants were recruited in Canada.
Recruitment	Data were aggregated from several open-science initiatives: the Quebec Parkinson Network, the PREVENT-AD open resource, and the OMEGA repository.
Ethics oversight	The Research Ethics Board at the Montreal Neurological Institute reviewed and approved this study.

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	Parkinson's disease is a highly heterogeneous disorder. As such, from the available open datasets, the largest sample size that met our inclusion/exclusion criteria was selected.
Data exclusions	Exclusionary criteria for all participants included current neurological (other than PD) or psychiatric disorder; MEG contraindications; and unusable MEG, speech sample, or demographic data.
Replication	This is not a replication study. However, the general patterns of neurophysiological change seen in our data align well with previous literature.
Randomization	Not relevant - participants were assigned based on whether they had a clinical diagnosis of idiopathic Parkinson's disease.
Blinding	Blinding during collection was not possible, due to the nature of the open science initiatives for which the data were collected. However, all data collection procedures were standardized. Initial preprocessing was performed on data without group identifiers.

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 | Included in the study |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Antibodies |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Eukaryotic cell lines |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Palaeontology and archaeology |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Animals and other organisms |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Clinical data |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Dual use research of concern |

Methods

- | n/a | Included in the study |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> ChIP-seq |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Flow cytometry |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> MRI-based neuroimaging |