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Last updated by author(s): Aug 26, 2024

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	No Software was used.
Data analysis	Python code for the phase coherence k-means analysis and statistical analysis is freely available (https://github.com/Krigsa/phase_coherence_kmeans)

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

Anesthesia dataset openly available (https://openneuro.org/datasets/ds003171/versions/1.0.0)
The dataset of sleep is available on request from nztglzcch@gmail.com

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	Anesthesia: 19 volunteers were recruited (18–40 years; 13 males). A total of 63 healthy subjects (36 females)
Reporting on race, ethnicity, or other socially relevant groupings	N/A
Population characteristics	Sleep: A total of 63 healthy subjects were selected from a data set previously described in a sleep-related study (Tagliazucchi and Laufs 2014). Anesthesia: 19 volunteers were recruited (18–40 years; 13 males). Volunteers were right-handed, native English speakers, and had no history of neurological disorders.
Recruitment	Sleep: A total of 63 healthy subjects were selected from a data set previously described in a sleep-related study by Tagliazucchi and Laufs (Tagliazucchi and Laufs 2014). Anesthesia: The propofol data employed in this study have been published before (Luppi et al. 2019; Varley et al. 2020; Naci et al. 2018; Kandeepan et al. 2020). Healthy volunteers were recruited. Volunteers were right-handed, native English speakers, and had no history of neurological disorders. In accordance with relevant ethical guidelines, each volunteer provided written informed consent, and received monetary compensation for their time.
Ethics oversight	Sleep: Goethe-Universität Frankfurt Anesthesia: Health Sciences Research Ethics Board and Psychology Research Ethics Board of Western University (Ontario, Canada)

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	Sleep dataset: No sample size calculation was performed. A total of 18 healthy volunteers' data was selected out of the 63 scanned due to non-contiguousness of their time series. Anesthesia dataset: No sample size calculation was performed. 19 healthy volunteers were recruited, but due to equipment malfunction, only 16 were left for analysis.
Data exclusions	Anesthesia dataset: From the 19 healthy volunteers recruited, only 16 were left for analysis, due to equipment malfunction. Sleep dataset: A total of 18 healthy volunteers' data was selected out of the 63 scanned due to non-contiguousness of their time series.
Replication	Considering the small datasets we have, we did not consider replication. However, the consistency of our results with previous results in the field confirm the replicability of our approach.
Randomization	All the participants were present in all the different groups respectively to the experiment they were part of.
Blinding	Blinding was not relevant to our study, as the states of interest were awake, general anethesia and deep sleep.

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: Both experimental designs were resting-states in absence of any task.

Design specifications: *Specify the number of blocks, trials or experimental units per session and/or subject, and specify the length of each trial or block (if trials are blocked) and interval between trials.*

Behavioral performance measures: Anesthesia dataset: Ramsay sedation score, level 5 was associated with absence of responsiveness and the beginning of the acquisition.
Sleep dataset: EEG to assess sleep stages

Acquisition

Imaging type(s): functional MRI

Field strength: 3T (both datasets)

Sequence & imaging parameters: Anesthesia experiments:3-Tesla Siemens Tim Trio scanner (32-channel coil), and 256 functional volumes (echo-planar images, EPI) were collected from each participant, with the following parameters: slices=33, with 25% inter-slice gap; resolution=3mm isotropic; TR=2000ms; TE=30ms; flip angle=75 degrees; matrix size=64×64.

Sleep experiments: 3-Tesla Siemens Trio scanner (Erlangen, Germany) and fMRI acquisition parameters were 1505 volumes of T2-weighted echo planar images, TR/TE = 2080ms/30ms, matrix 64×64, voxel size 3×3×3, distance factor 50%; FOV 192 . An optimized polysomnographic setting was employed (chin and tibial EMG, ECG, EOG recorded bipolarly [sampling rate 5 kHz, low pass filter 1 kHz] with 30 EEG channels recorded with FCz as the reference [sampling rate 5 kHz, low pass filter 250 Hz]. Pulse oximetry and respiration were recorded via sensors from the Trio [sampling rate 50 Hz]) and MR scanner-compatible devices (BrainAmp MR+, BrainAmpExG; Brain Products, Gilching, Germany)

Area of acquisition: Whole Brain Scans

Diffusion MRI ☒ Used ☐ Not used

Parameters: *Specify # of directions, b-values, whether single shell or multi-shell, and if cardiac gating was used.*

Preprocessing

Preprocessing software: SPM12-based CONN toolbox, version 17f.

Normalization: *If data were normalized/standardized, describe the approach(es): specify linear or non-linear and define image types used for*

Normalization

transformation OR indicate that data were not normalized and explain rationale for lack of normalization.

Normalization template

Describe the template used for normalization/transformation, specifying subject space or group standardized space (e.g. original Talairach, MNI305, ICBM152) OR indicate that the data were not normalized.

Noise and artifact removal

The method RETROICOR was uses to model physiological noise (Respiration effects and cardiac pulsatility) and use it to denoise the data.

Volume censoring

Define your software and/or method and criteria for volume censoring, and state the extent of such censoring.

Statistical modeling & inference

Model type and settings

Specify type (mass univariate, multivariate, RSA, predictive, etc.) and describe essential details of the model at the first and second levels (e.g. fixed, random or mixed effects; drift or auto-correlation).

Effect(s) tested

Two sided paired t-tests were used to compare the different conditions, from their respective datasets together, with Bonferroni correction in the case of the anesthesia data (since we have 3 conditions). Repeated measures ANOVA was also used for the latter since the same subjects experienced both loss and recovery of consciousness.

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

Anatomical location(s)

ROIs were based on the Desikan-Killiany atlas with 68 regions for the anesthesia experiments, and the AAL90 (with 90 regions) for the sleep experiments.

Statistic type for inference

Paired t-test was used for comparaison between conditions.

(See Eklund et al. 2016)

Correction

Bonferroni correction was used to adress the multiple comparisons problem.

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

Angular differences between instantaneous phases of the Hilbert transforms of BOLD-signals was used as measure of synchronization.