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Supplementary Figures: 4

Supplementary Tables: 4

Supplementary Videos: 0

Reporting Checklist for Nature Neuroscience

This checklist is used to ensure good reporting standards and to improve the reproducibility of published results. For more information, please read Reporting Life Sciences Research.

Please note that in the event of publication, it is mandatory that authors include all relevant methodological and statistical information in the manuscript.

Statistics reporting, by figure

- Please specify the following information for each panel reporting quantitative data, and where each item is reported (section, e.g. Results, & paragraph number).
- Each figure legend should ideally contain an exact sample size (n) for each experimental group/condition, where n is an exact number and not a range, a clear definition of how n is defined (for example x cells from x slices from x animals from x litters, collected over x days), a description of the statistical test used, the results of the tests, any descriptive statistics and clearly defined error bars if applicable.
- For any experiments using custom statistics, please indicate the test used and stats obtained for each experiment.
- Each figure legend should include a statement of how many times the experiment shown was replicated in the lab; the details of sample collection should be sufficiently clear so that the replicability of the experiment is obvious to the reader.
- For experiments reported in the text but not in the figures, please use the paragraph number instead of the figure number.

Note: Mean and standard deviation are not appropriate on small samples, and plotting independent data points is usually more informative. When technical replicates are reported, error and significance measures reflect the experimental variability and not the variability of the biological process; it is misleading not to state this clearly.

		TEST USED		n			DESCRIPTIVE STATS (AVERAGE, VARIANCE)		P VALUE		DEGREES OF FREEDOM & F/t/z/R/ETC VALUE	
	FIGURE NUMBER	WHICH TEST?	SECTION & PARAGRAPH #	EXACT VALUE	DEFINED?	SECTION & PARAGRAPH #	REPORTED?	SECTION & PARAGRAPH #	EXACT VALUE	SECTION & PARAGRAPH #	VALUE	SECTION & PARAGRAPH #
example	1a	one-way ANOVA	Fig. legend	9, 9, 10, 15	mice from at least 3 litters/group	Methods para 8	error bars are mean +/- SEM	Fig. legend	p = 0.044	Fig. legend	F(3, 36) = 2.97	Fig. legend
example	results, para 6	unpaired t-test	Results para 6	15	slices from 10 mice	Results para 6	error bars are mean +/- SEM	Results para 6	p = 0.0006	Results para 6	t(28) = 2.808	Results para 6

		TEST USED		n			DESCRIPTIVE STATS (AVERAGE, VARIANCE)		P VALUE		DEGREES OF FREEDOM & F/t/z/R/ETC VALUE	
	FIGURE NUMBER	WHICH TEST?	SECTION & PARAGRAPH #	EXACT VALUE	DEFINED?	SECTION & PARAGRAPH #	REPORTED?	SECTION & PARAGRAPH #	EXACT VALUE	SECTION & PARAGRAPH #	VALUE	SECTION & PARAGRAPH #
+ -	1a	two-tailed paired t-test	Fig. legend	32	subjects	Fig. legend	t-values		p<0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(31) > 2.0395	Fig. legend
+ -	1b	two-tailed, paired t-tests	Fig. legend	20	subjects	Fig. legend	t-values	Fig. legend	< 0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(19) > 2.0930	Fig. legend
+ -	2a	two-tailed, paired t-tests	Fig. legend	10	subjects	Fig. legend	t-values	Fig. legend	< 0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(9) > 2.2622	Fig. legend
+ -	3a	two-tailed, paired t-tests	Fig. legend	32	subjects	Fig. legend	t values	Fig. legend	< 0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(31) > 2.0395	Fig. legend
+ -	3b	two-tailed, paired t-tests	Fig. legend	20	subjects	Fig. legend	t values	Fig. legend	< 0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(19) > 2.0930	Fig. legend
+ -	3c	two-tailed, paired t-tests	Fig. legend	10	subjects	Fig. legend	t values	Fig. legend	< 0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(9) > 2.2622	Fig. legend
+ -	4a	Spearman rank correlation	Fig. legend	7	subjects	Fig. legend	average (Spearman r) and permutation test	Fig. legend	p<0.05 (exact value depends on voxel)	Fig. legend, results paragraph 11	r>0.14	Fig. legend
+ -	4b	Difference (face minus no face) and one-tailed ttest in region of interest	Fig. legend	7	subjects	Fig. legend	average	Fig. legend	p=0.023	Fig. legend	t(6) = 2.10	Fig. legend
+ -	4c	one-tailed paired ttests	Fig. legend	6, 7 and 7	subjects	Fig. legend	average	Fig. legend	< 0.05 (exact value depends on voxel)	Fig. legend	t(6) > 2.4469 t(5) > 2.5706 t(6) > 2.4469	Fig. legend
+ -	5b	one tailed t-test	Fig. legend	7	subjects	Fig. legend	average	Fig. legend	p=0.00001; p=0.0003	Fig. legend	t(1,6)= 13.25; t(1,6)= 7.39	Fig. legend
+ -	5c	two-tailed paired t-test	Fig. legend	7	subjects	Fig. legend	average	Fig. legend	p=0.001; p=0.001	Fig. legend	t(1,6)= -6.52; t(1,6)=6.38	Fig. legend
+ -	5d	two-tailed paired t-test	Fig. legend	7	subjects	Fig. legend	average	Fig. legend	p<0.001 FDR cluster corrected	Fig. legend	t(6) > 5.95	Fig. legend

+ -	S1a	two-tailed, paired t-test	Fig. legend	7	subjects	Fig. legend	t-values	Fig. legend	p<0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(6) ≥ 2.45	Fig. legend
+ -	S1b	two-tailed, paired t-test	Fig. legend	7	subject	Fig. legend	t-values	Fig. legend	p<0.05 SnPM corrected (exact value depends on voxel)	Fig. legend	t(6) ≥ 2.45	Fig. legend
+ -	S5a	two-tailed paired t-test (NREM LF)	Fig. legend	32	subjects	Fig. legend	average	Figure legend	p=0.006	Figure	t(31)=-2.98	Fig. legend
+ -	S5b	two-tailed paired t-test (REM LF)	Fig. legend	10	subjects	Fig. legend	average	Figure legend	p=0.006	Figure	t(9)=-3.59	Fig. legend
+ -	S5c	two-tailed paired t-test (NREM HF)	Fig. legend	32	subjects	Fig. legend	average	Figure legend	p=0.002	Figure	t(31)=3.46	Fig. legend
+ -	S5d	two-tailed paired t-test (REM HF)	Fig. legend	10	subjects	Fig. legend	average	Figure legend	p=0.013	Figure	t(9)=3.10	Fig. legend
+ -	S3	two-tailed, paired t-tests	Fig. legend	32	subjects	Fig. legend	t-values	Figure legend	< 0.05 SnPM corrected (exact value depends on voxel)	Figure legend	t(31) > 2.04	Fig. legend
+ -	S6	two-tailed, paired t-tests	Fig. legend	7	subjects	Fig. legend	t-values	Figure legend	p=0.005	Figure legend	t(6)=4.41	Fig. legend
+ -	S7	two-tailed, paired t-tests	Fig. legend	7	subjects	Fig. legend	t-values	Figure legend	< 0.05 SnPM corrected (exact value depends on voxel)	Figure legend	t(6) ≥ 2.45	Fig. legend
+ -	S8	two-tailed, paired t-tests	Fig. legend	32 and 7	subjects	Fig. legend	t-values	Figure legend	unthresholded (for thresholded tvalues, see Figure 1 and Supp Fig. 1)	Figure legend	Whole scale is shown (0-3.5)	Fig. legend
+ -	S4a	two-tailed, paired t-tests	Fig. legend	20	subjects	Fig. legend	t-values	Figure legend	p<0.05	Figure legend	t(19) > 2.0930	Fig. legend
+ -	S4b	two-tailed, paired t-tests	FIg. legend	20	subjects	FIg. legend	t-values	Figure legend	unthresholded (for thresholded tvalues, see Figure S4a)	Figure legend	Whole scale is shown (0-3)	Fig.legend
+ -	Supp Table 5	ANOVA	Table legend	32	subjects of experiment 1, NREM, DE vs NE, LF	Supp. Table 5	Average values are shown in Figure 1A	FIgure 1	p=0.41	Supp. Table 5	F(1,31)=0.699	Supp. Table 5
+ -	Supp Table 5	ANOVA	Table legend	32	subjects of experiment 1, NREM DE vs NE, HF	Supp. Table 5	Average values are shown in Figure 3A	Figure 3	p=0.96	Supp Table 5	F(1,31)=0.002	Supp . Table 5
+ -	Supp Table 5	ANOVA	Table legend	7	subjects of experiment 2, NREM DE vs NE, LF	Supp. Table 5	Average values are shown in Fig S1A	Figure S1A	p=0.32	Supp Table 5	F(1,6)=1.127	Supp. Table 5
+ -	Supp Table 5	ANOVA	Table legend	7	subjects of experiment 2, NREM, DE vs NE, HF	Supp. Table 5	Average values are shown in Fig S1B	Fig S1B	p=0.39	Supp. Table 5	F(1,6)=0.822	Supp. Table 5
+ -	Supp Table 5	ANOVA	Table legend	20	subjects of experiment 1, NREM, DEWR vs NE, LF	Supp. Table 5	Average values shown in FIgure 1B	Figure 1B	p=0.35	Supp. Table 5	F(1,19)=0.902	Supp. Table 5

+ -	Supp. Table 5	ANOVA	Table legend	20	subjects of Experiment 1, NREM, DE vs DEWR, HF	Supp. Table 5	Average values shown in Figure 3B	Figure 3B	p=0.652	Supp. Table 5	F(1,19)=0.210	Supp. Table 5
+ -	Supp. Table 5	ANOVA	Table Legend	10	subjects of Experiments 1 and 2, REM, DE vs NE, LF	Supp. Table 5	Average valeus in Figure 2A	Figure 2A	p=0.133	Supp. Table 5	F(1,9)=2.727	Supp. Table 5
+ -	Supp. Table 5	ANOVA	Table legend	10	subjects of Experiments 1 and 2, REM, DE vs NE, HF	Supp. Table 5	Average values shown in Figure 3C	Figure 3C	p=0.046	Supp. Table 5	F(1,9)=5.334	Supp. Table 5
+ -	Fig. 4C	one-tailed paired ttest (ROI)	results para 12 and Fig. legend	6	subjects	Fig. legend	no, but average values for voxel by voxel contrast reported in Fig. 4C		p=0.023	Results para 12	t(5) > 2.57	Fig. legend
+ -	FIg. 4C	one-tailed paired ttest (ROI)	results para 12 and Fig. legend	7	subjects	Fig. legend	no, but average values for voxel by voxel contrast reported in Fig. 4C		p=0.029	Results para 12	t(6) > 2.45	Fig. legend
+ -	FIg. 4C	one-tailed paired ttest (ROI)	results para 12 and Fig. legend	7	subjects	Fig. legend	no, but average values for voxel by voxel contrast reported in Fig. 4C		p=0.048	Results para 12	t(6) > 2.45	Fig. legend
+ -	Figure 4B/C	Lilliefors test	methods paragraph 9	6 7 and 7	subjects	Figure legend	individual values not shown	methods paragraph 9	p>0.05	methods paragraph 9	t(5) < 2.57 t(6) < 2.45	methods paragraph 9

Representative figures

1. Are any representative images shown (including Western blots and immunohistochemistry/staining) in the paper?

   If so, what figure(s)?

   no

2. For each representative image, is there a clear statement of how many times this experiment was successfully repeated and a discussion of any limitations in repeatability?

   If so, where is this reported (section, paragraph #)?

   NA

Statistics and general methods

1. Is there a justification of the sample size?

   If so, how was it justified?

   Where (section, paragraph #)?

   Even if no sample size calculation was performed, authors should report why the sample size is adequate to measure their effect size.

   Given that this is the first study to assess differences in sleep consciousness using high-density EEG, no sample size calculation could be performed before the study. Other studies in which sleep was investigated using high-density EEG recordings (i.e., Huber et al., Nature 2004), have used a similar or smaller number of subjects (n=32 for experiment 1). Experiment 2 (n=7 but more awakenings) and experiment 3 (n=7, trial by trial consciousness prediction) confirmed the results, indicating both within-subject and within-trial consistency, respectively. A statement has been included on page 24, paragraph: 'Statistical Analysis'.

2. Are statistical tests justified as appropriate for every figure? Where (section, paragraph #)?	Yes
a. If there is a section summarizing the statistical methods in the methods, is the statistical test for each experiment clearly defined?	Yes, see Methods Section, under 'Statistical analysis'
b. Do the data meet the assumptions of the specific statistical test you chose (e.g. normality for a parametric test)? Where is this described (section, paragraph #)?	Yes, See Methods Section, under 'Statistical analysis'
c. Is there any estimate of variance within each group of data? Is the variance similar between groups that are being statistically compared? Where is this described (section, paragraph #)?	NA as within-subject comparisons were carried out
d. Are tests specified as one- or two-sided?	yes, in each figure legend
e. Are there adjustments for multiple comparisons?	An adjustment for multiple comparisons was applied to all the analyses except to the contrasts shown in Figure 4C. See methods section 'Experiments 1 and 2/Statistical analysis' for explanations.
3. To promote transparency, *Nature Neuroscience* has stopped allowing bar graphs to report statistics in the papers it publishes. If you have bar graphs in your paper, please make sure to switch them to dot-plots (with central and dispersion statistics displayed) or to box-and-whisker plots to show data distributions.	Ok
4. Are criteria for excluding data points reported? Was this criterion established prior to data collection? Where is this described (section, paragraph #)?	Yes, see methods section, paragraphs 'Study participants experiment 1' and 'Study participants experiment 2' .
5. Define the method of randomization used to assign subjects (or samples) to the experimental groups and to collect and process data. If no randomization was used, state so. Where does this appear (section, paragraph #)?	As within-subject contrasts were performed, no randomization in the organization of the experimental conditions was performed. This is indicated in the paragraph "Statistical Analyses" of the Methods section.
6. Is a statement of the extent to which investigator knew the group allocation during the experiment and in assessing outcome included? If no blinding was done, state so. Where (section, paragraph #)?	Data collection and analysis were not performed blind to the conditions of the experiments. This has been indicated in the methods section, at the end of the first paragraph.
7. For experiments in live vertebrates, is a statement of compliance with ethical guidelines/regulations included? Where (section, paragraph #)?	NA

8. Is the species of the animals used reported?

   Where (section, paragraph #)?

NA

9. Is the strain of the animals (including background strains of KO/ transgenic animals used) reported?

   Where (section, paragraph #)?

NA

10. Is the sex of the animals/subjects used reported?

    Where (section, paragraph #)?

Yes, see methods section, paragraphs 'Study participants experiment 1', 'Study participants experiment 2' and 'Study participants experiment 3'

11. Is the age of the animals/subjects reported?

    Where (section, paragraph #)?

Yes, see methods section, paragraphs 'Study participants experiment 1', 'Study participants experiment 2' and 'Study participants experiment 3'

12. For animals housed in a vivarium, is the light/dark cycle reported?

    Where (section, paragraph #)?

NA

13. For animals housed in a vivarium, is the housing group (i.e. number of animals per cage) reported?

    Where (section, paragraph #)?

NA

14. For behavioral experiments, is the time of day reported (e.g. light or dark cycle)?

    Where (section, paragraph #)?

NA

15. Is the previous history of the animals/subjects (e.g. prior drug administration, surgery, behavioral testing) reported?

    Where (section, paragraph #)?

NA

    a. If multiple behavioral tests were conducted in the same group of animals, is this reported?

       Where (section, paragraph #)?

NA

16. If any animals/subjects were excluded from analysis, is this reported?

    Where (section, paragraph #)?

NA

    a. How were the criteria for exclusion defined?

       Where is this described (section, paragraph #)?

NA

    b. Specify reasons for any discrepancy between the number of animals at the beginning and end of the study.

       Where is this described (section, paragraph #)?

NA

Reagents

1. Have antibodies been validated for use in the system under study (assay and species)?

   NA

   a. Is antibody catalog number given?

      Where does this appear (section, paragraph #)?

      NA

   b. Where were the validation data reported (citation, supplementary information, Antibodypedia)?

      Where does this appear (section, paragraph #)?

      NA

2. Cell line identity

   a. Are any cell lines used in this paper listed in the database of commonly misidentified cell lines maintained by ICLAC and NCBI Biosample?

      Where (section, paragraph #)?

      NA

   b. If yes, include in the Methods section a scientific justification of their use--indicate here in which section and paragraph the justification can be found.

      NA

   c. For each cell line, include in the Methods section a statement that specifies:
      - the source of the cell lines
      - have the cell lines been authenticated? If so, by which method?
      - have the cell lines been tested for mycoplasma contamination?

      Where (section, paragraph #)?

      NA

Data availability

Provide a Data availability statement in the Methods section under "Data availability", which should include, where applicable:

- Accession codes for deposited data
- Other unique identifiers (such as DOIs and hyperlinks for any other datasets)
- At a minimum, a statement confirming that all relevant data are available from the authors
- Formal citations of datasets that are assigned DOIs
- A statement regarding data available in the manuscript as source data
- A statement regarding data available with restrictions

See our data availability and data citations policy page for more information.

Data deposition in a public repository is mandatory for:

a. Protein, DNA and RNA sequences
b. Macromolecular structures
c. Crystallographic data for small molecules
d. Microarray data

Deposition is strongly recommended for many other datasets for which structured public repositories exist; more details on our data policy are available here. We encourage the provision of other source data in supplementary information or in unstructured repositories such as Figshare and Dryad.

We encourage publication of Data Descriptors (see Scientific Data) to maximize data reuse.

Where is the Data Availability statement provided (section, paragraph #)?

Data that are relevant to the publication are available upon request. See Methods section /'Data availability'.

Computer code/software

Any custom algorithm/software that is central to the methods must be supplied by the authors in a usable and readable form for readers at the time of publication. However, referees may ask for this information at any time during the review process.

1. Identify all custom software or scripts that were required to conduct the study and where in the procedures each was used.

Custom Matlab scripts were used to calculate spectral power density in different frequency bands using the p-Welch Matlab function and to run the permutation test on the correlations (Fig. 4A).

2. If computer code was used to generate results that are central to the paper's conclusions, include a statement in the Methods section under "**Code availability**" to indicate whether and how the code can be accessed. Include version information as necessary and any restrictions on availability.

Human subjects

1. Which IRB approved the protocol?

   Where is this stated (section, paragraph #)?

   University of Wisconsin Institutional Review Board

2. Is demographic information on all subjects provided?

   Where (section, paragraph #)?

   Yes, see methods section, paragraphs 'Study participants experiment 1', 'Study participants experiment 2' and 'Study participants experiment 3'

3. Is the number of human subjects, their age and sex clearly defined?

   Where (section, paragraph #)?

   Yes, see methods section, paragraphs 'Study participants experiment 1', 'Study participants experiment 2' and 'Study participants experiment 3'

4. Are the inclusion and exclusion criteria (if any) clearly specified?

   Where (section, paragraph #)?

   Yes, see methods section, paragraphs 'Study participants experiment 1', 'Study participants experiment 2' and 'Study participants experiment 3'

5. How well were the groups matched?

   Where is this information described (section, paragraph #)?

   NA

6. Is a statement included confirming that informed consent was obtained from all subjects?

   Where (section, paragraph #)?

   Yes, see methods section, paragraph 'Experiments 1 ans 2/ Procedure' and 'Study participants experiment 3'

7. For publication of patient photos, is a statement included confirming that consent to publish was obtained?

   Where (section, paragraph #)?

   NA

fMRI studies

For papers reporting functional imaging (fMRI) results please ensure that these minimal reporting guidelines are met and that all this information is clearly provided in the methods:

1. Were any subjects scanned but then rejected for the analysis after the data was collected?

   a. If yes, is the number rejected and reasons for rejection described?

      Where (section, paragraph #)?

2. Is the number of blocks, trials or experimental units per session and/ or subjects specified?

   Where (section, paragraph #)?

3. Is the length of each trial and interval between trials specified?

4. Is a blocked, event-related, or mixed design being used? If applicable, please specify the block length or how the event-related or mixed design was optimized.

5. Is the task design clearly described?

   Where (section, paragraph #)?

6. How was behavioral performance measured?

7. Is an ANOVA or factorial design being used?

8. For data acquisition, is a whole brain scan used?

   If not, state area of acquisition.

   a. How was this region determined?

9. Is the field strength (in Tesla) of the MRI system stated?

   a. Is the pulse sequence type (gradient/spin echo, EPI/spiral) stated?

   b. Are the field-of-view, matrix size, slice thickness, and TE/TR/flip angle clearly stated?

10. Are the software and specific parameters (model/functions, smoothing kernel size if applicable, etc.) used for data processing and pre-processing clearly stated?

11. Is the coordinate space for the anatomical/functional imaging data clearly defined as subject/native space or standardized stereotaxic space, e.g., original Talairach, MNI305, ICBM152, etc? Where (section, paragraph #)?

12. If there was data normalization/standardization to a specific space template, are the type of transformation (linear vs. nonlinear) used and image types being transformed clearly described? Where (section, paragraph #)?

13. How were anatomical locations determined, e.g., via an automated labeling algorithm (AAL), standardized coordinate database (Talairach daemon), probabilistic atlases, etc.?

14. Were any additional regressors (behavioral covariates, motion etc) used?

15. Is the contrast construction clearly defined?

16. Is a mixed/random effects or fixed inference used?

   a. If fixed effects inference used, is this justified?

17. Were repeated measures used (multiple measurements per subject)?

a. If so, are the method to account for within subject correlation and the assumptions made about variance clearly stated?

18. If the threshold used for inference and visualization in figures varies, is this clearly stated?

19. Are statistical inferences corrected for multiple comparisons?

a. If not, is this labeled as uncorrected?

20. Are the results based on an ROI (region of interest) analysis?

a. If so, is the rationale clearly described?

b. How were the ROI's defined (functional vs anatomical localization)?

21. Is there correction for multiple comparisons within each voxel?

22. For cluster-wise significance, is the cluster-defining threshold and the corrected significance level defined?

Additional comments

Additional Comments