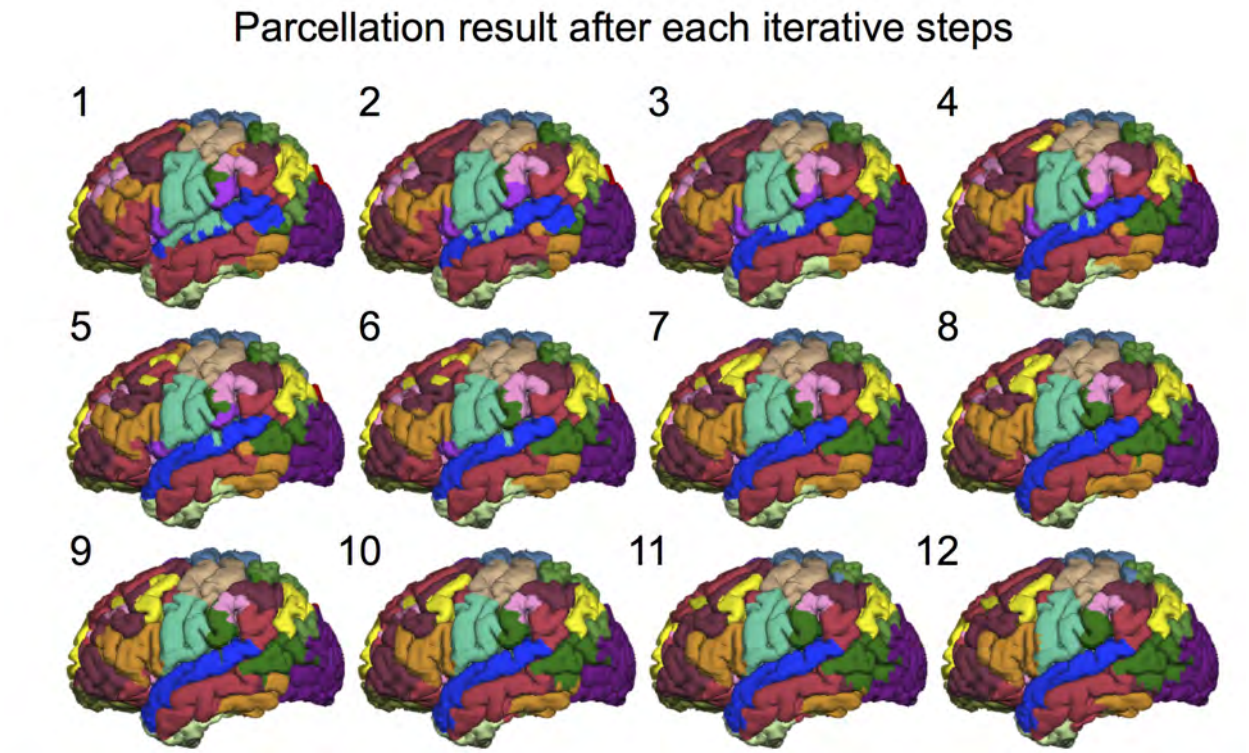

Supplementary Figure 1

Functional cortical parcellation is gradually refined In the iterative procedure.

The maps show the results of an individual subject for 12 iterations. The functional map was gradually modified as the iteration proceeded and then reached a stable solution. The vertices in the primary visual and sensorimotor regions showed relative stable assignment over the iterations. However, vertices in the association cortices showed greater adjustment over the iterations. For example, in the lateral frontal lobe, the red network shrank after several iterations and the yellow network started to appear in the superior frontal lobe after the fourth iteration, expanding as the iteration proceeded.

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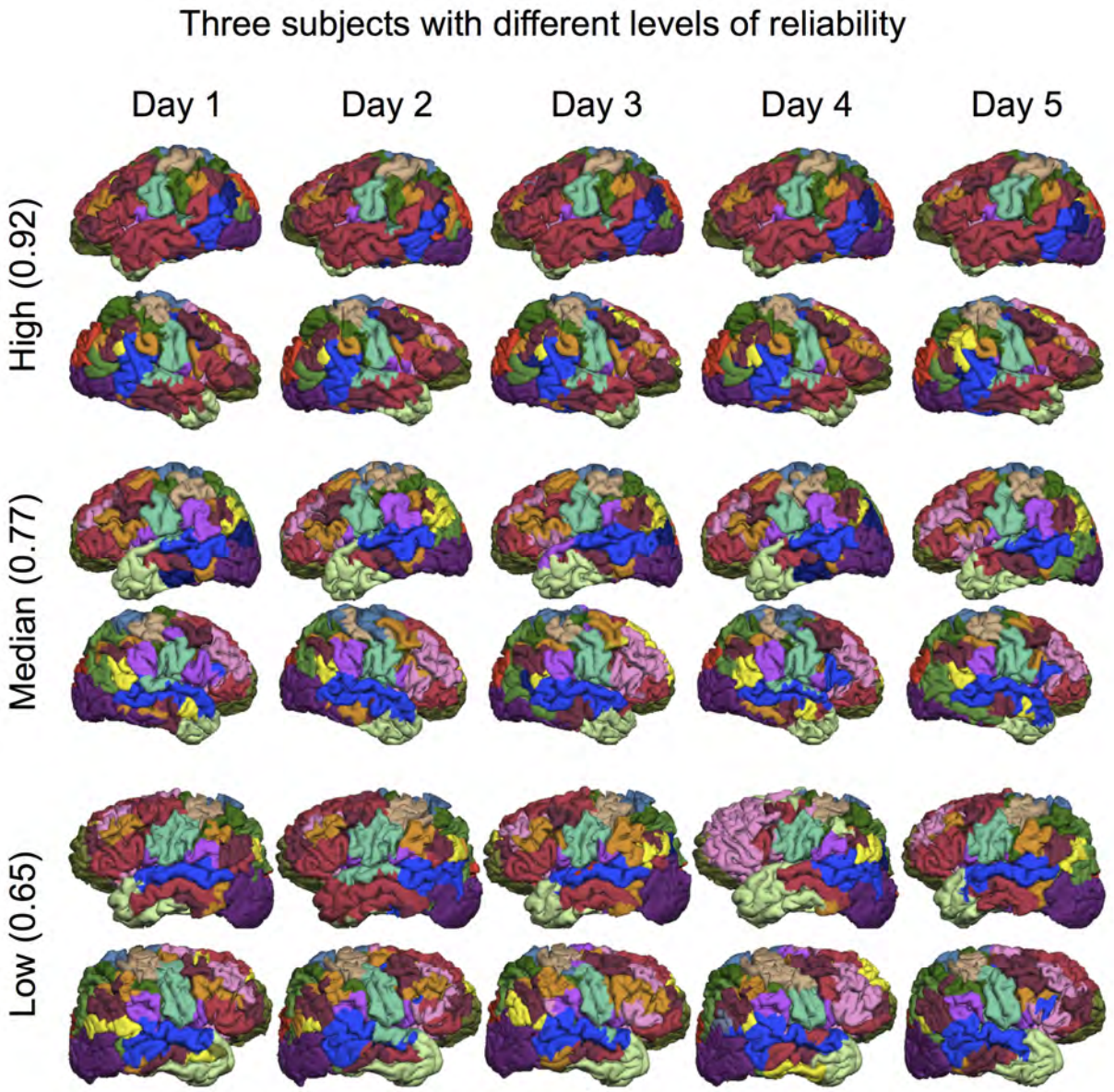
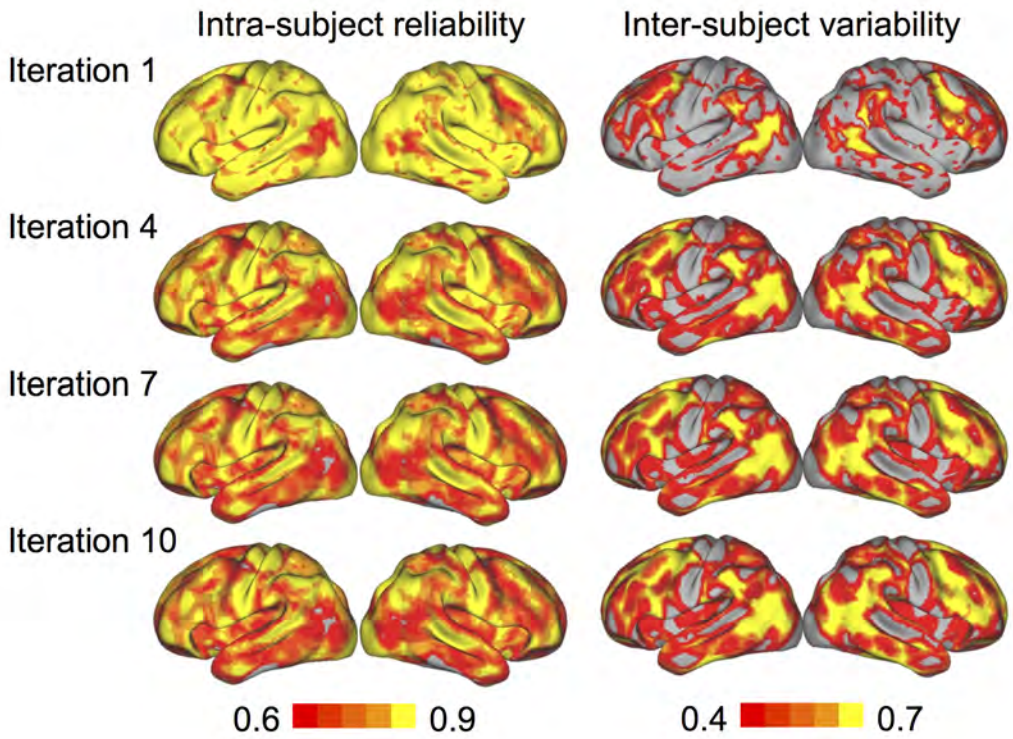


Supplementary Figure 2

Individual parcellation captures differences across subjects and achieves high reproducibility within subjects.

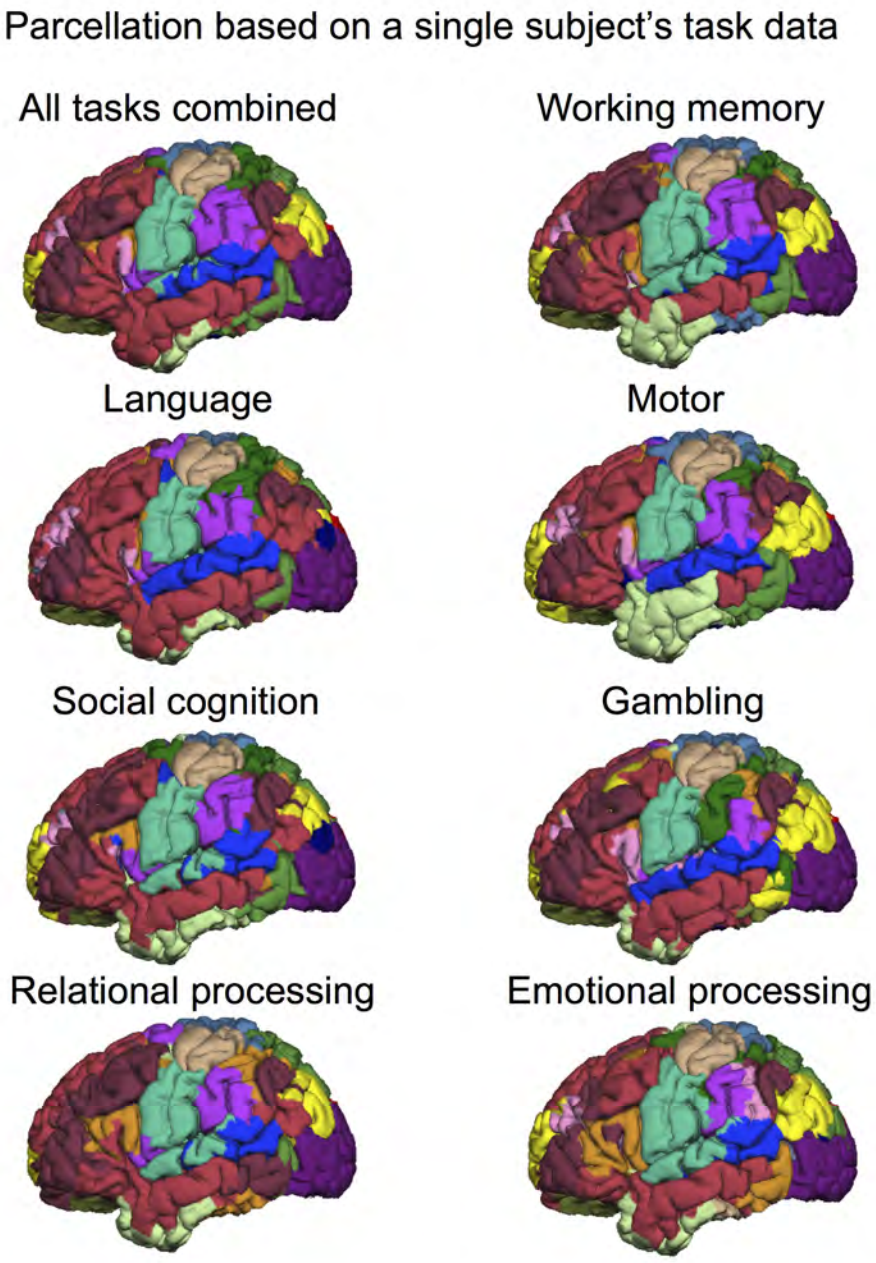
The maps display the results in both hemispheres for three subjects from Dataset I that showed the highest, median, and lowest reproducibility across five sessions (mean Dice Coefficients are 92%, 77%, and 65%, respectively).



Supplementary Figure 3

Intra-subject reliability and inter-subject variability of network parcellation.

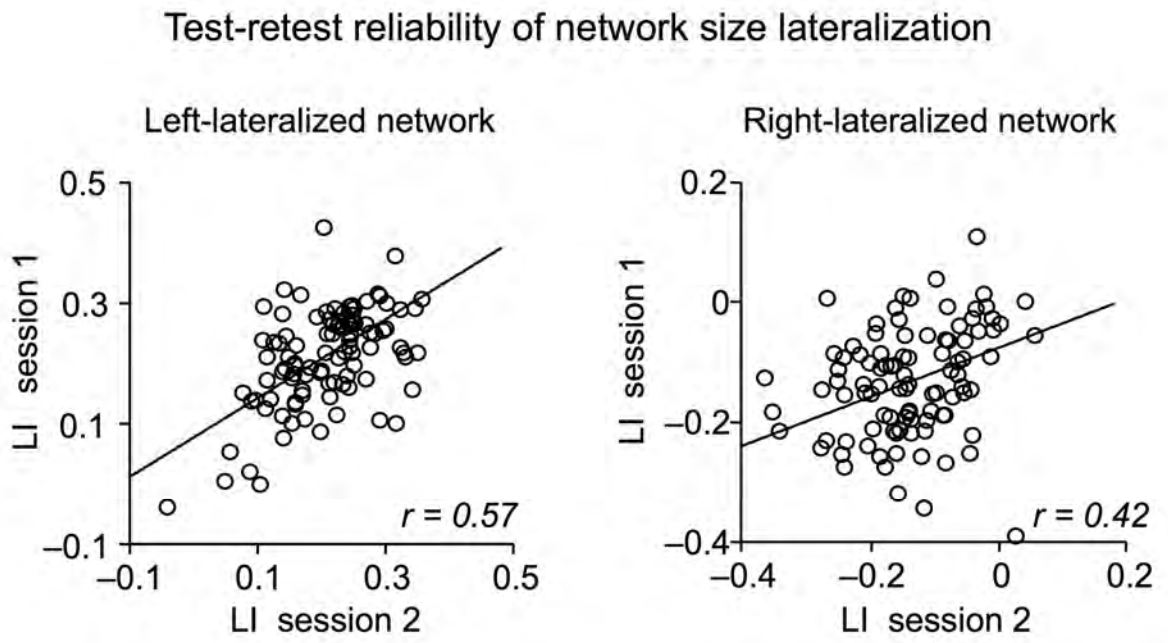
The maps demonstrate the spatial distribution of reliability and variability after each iteration. As the iterative search progressed, reliability decreased while variability increased. Inter-subject variability was most prominent in the association areas.



Supplementary Figure 4

Parcellation results based on the task fMRI data.

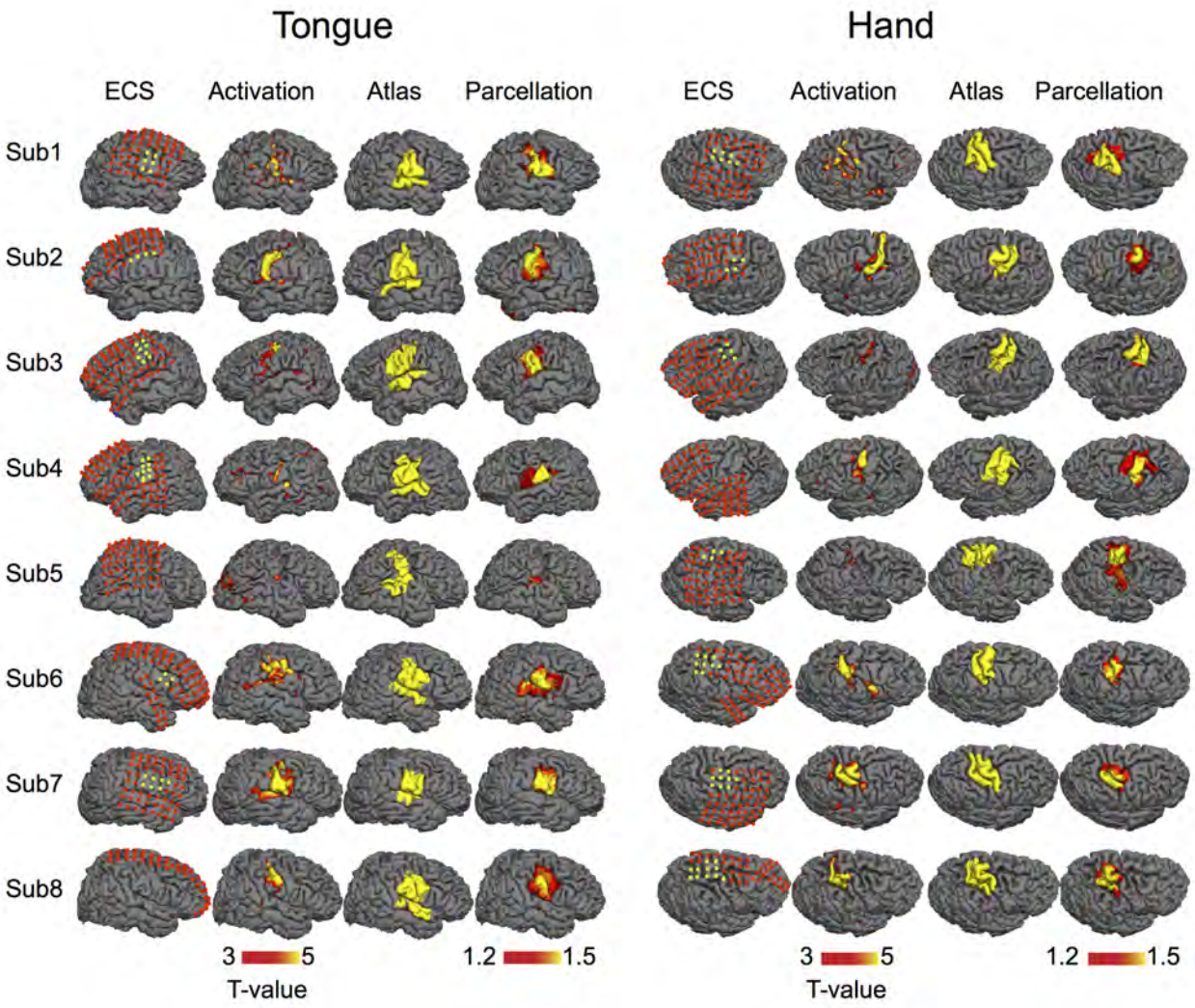
The maps demonstrate the parcellation results of a subject based on the concatenated task data and the data of single tasks.



Supplementary Figure 5

Test-retest reliability of the network lateralization.

The intra-subject test-retest reliability of the LI was computed using the two resting-state sessions of each subject. The relation of the LIs derived from the two scanning sessions was plotted for 100 HCP subjects. Each circle in the scatterplots represents a subject. For the most left-lateralized network, the lateralization indices estimated in the two sessions showed a correlation coefficient of 0.57 ($p<10^{-9}$). For the most right-lateralized network, the correlation between the two sessions was 0.42 ($p<10^{-4}$).

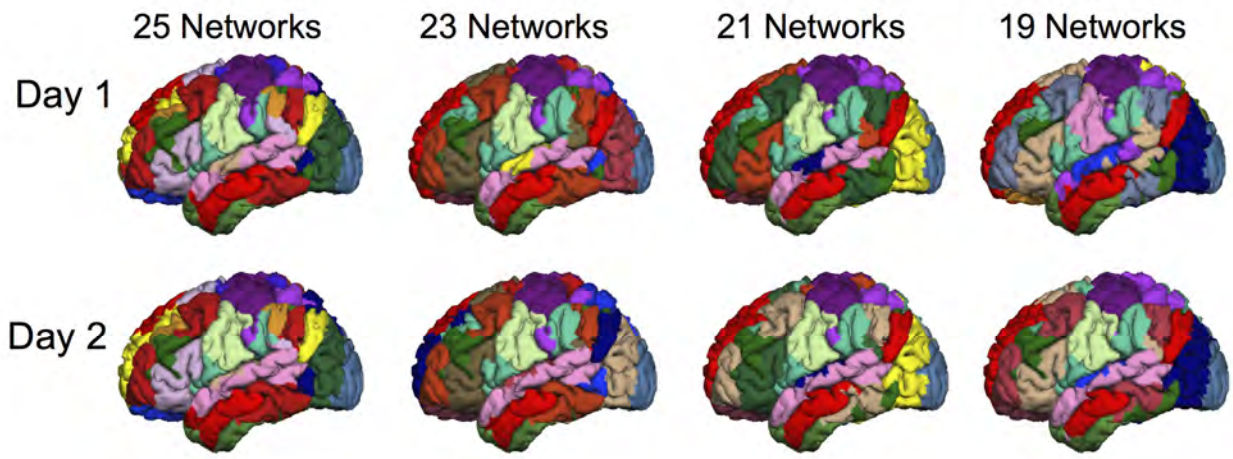


Supplementary Figure 6

Tongue and hand sensorimotor areas localized by ECS, traditional task activation fMRI, direct projection of the population-based atlas to the individual, and iterative cortical parcellation.

Each row represents the results of one patient. The mapping results were projected to each individual's cortical surface reconstructed from the MRI T1 images. The four columns on the left illustrate the tongue regions, while the four columns on the right show the hand regions. The red dots on the ECS maps indicate negative electrodes (no symptoms related to the sensorimotor cortex were reported when stimulated), while the yellow dots indicate positive electrodes. Compared to task fMRI activation maps, the high-confidence target regions identified by the iterative parcellation approach were more consistent with the results of ECS. The iterative parcellation also outperformed the direct projection of the population-based atlas to the individual subject's cortical surface.

Nature Neuroscience: doi:10.1038/nn.4164



Supplementary Figure 7

Iterative parcellation with the number of networks flexibly determined in each individual.

The iterative parcellation procedure was initiated from a population-based atlas consisting of 25 networks. The number of networks was gradually adjusted by merging the networks with similar time courses (e.g., r >0.5). Once a merger occurred, the iterative parcellation was restarted with the reduced number of networks. The parcellation results of a single subject using this strategy were displayed. The parcellation started at 25 networks and converged into 19 networks. The parcellation maps showed high reproducibility across two different days. The color scheme of the networks was arbitrarily selected for each map.

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Table S1
Demographic and Imaging Characteristics

Measures	Left-handed		Right-handed		Diff	
	Mean	STD	Mean	STD	p-value	t-value
Age (yr)	19.9	1.9	19.9	1.7	0.90	0.12
Education(yr)	13.8	1.7	13.8	1.5	0.67	0.42
Handedness	-16.7	4.8	16.6	4.7	--	
Runs	2	0	2	0	--	
Displacement(mm)	0.05	0.02	0.05	0.02	0.92	0.09
SNR	183.4	36.4	183.4	34.0	0.98	0.03

Note: Two groups were also matched for: Scanner, Console, Coil, Ethnicity (5 Hispanic subjects in each group), and Investigator. p values were based on two-tailed t-test.

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Supplementary Figures: 7

Supplementary Tables: 1

Supplementary Videos:

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
+ -												

Nature Neuroscience: doi:10.1038/nn.4164

		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 #
+ -	3c	unpaired two-tailed t-test	Fig. legend; Results para 5	100	unrelated subjects from HCP	Fig. legend; Results para 3	error bars are mean +/-SD	Fig. legend	p<0.001	Fig. legend; Results para 5	t(5048) = 91.0	Results para 5
+ -	3c	paired two-tailed t-test	Fig. legend; Results para,6	100	unrelated subjects from HCP	Fig. legend; Results para 3	error bars are mean +/-SD	Fig. legend	p= 0.08	Fig. legend; Results para 6	t(99) =1.76	Results para 6
+ -	4b	General Linear Model	Fig. legend	100	unrelated subjects from HCP	Fig. legend; Results para 3			p< 0.05	Fig. legend Results para 7	Z>1.96	Fig. legend Results para 7
+ -	4c	unpaired two-tailed t-test	Results para 8	104	52 left handed and 52 right handed subjects	Fig. legend; Results para 8	error bars are mean +/-SEM	Fig. legend	p=0.057 p=0.003	Fig. legend; Results para 8	t(102) =1.9 t(102) =3.1	Results para 8
+ -	results, Para 10	paired two-tailed t-test	Results para 10	100	unrelated subjects from HCP	Fig. legend; Results para 3			p<0.001 p<0.001		t(99) =11.2 t(99) =21.9	Results para 10
+ -	5e	Wilcoxon rank sum test	Results para 13&14	8	8 surgical subjects	Fig. legend; Online Methods para 6	area under curve	Results para 13 &14	p=0.008 p=0.015 p=0.22 p=0.015	Results para 13 &14		
+ -	s5	Pearson's correlation	Fig. legend	100	unrelated subjects from HCP	Fig. legend; Results para 3			p<10e-9 p<10e-4	Fig. legend	r=0.57 r=0.42	Fig. legend
+ -	s6	General Linear Model	Online Methods para 13,14	8	8 surgical subjects	Fig. legend; Online Methods para 6					3<t<5	Fig. legend

Representative figures

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

   If so, what figure(s)?

   Fig 2, Fig 3b &3d, Fig 5a-5d

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 #)?

   Not applicable

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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.	Results shown in Figures 2 were based on 23 healthy subjects. Results in Figure 3, Figure 4a &4b were based on 100 HCP subjects. Results in Figure 4c were based on 52 left handed and 52 right handed subjects. Results in Figure 5e were based on 8 surgical patients. No statistical methods were used to pre-determine sample sizes but our sample sizes are larger than or similar to those reported in previous publications. This is stated in Online Methods section, para 20.
2. Are statistical tests justified as appropriate for every figure? Where (section, paragraph #)?	Two-tailed t-test was used for all comparisons in this study except for the experiment shown in Figure 5, which used Wilcoxon rank sum test. For the t-tests, data distribution was assumed to be normal but this was not formally tested. This is stated in Online Methods section, para 20.
a. If there is a section summarizing the statistical methods in the methods, is the statistical test for each experiment clearly defined?	Two-tailed t-test was used for all comparisons in this study except for the experiment shown in Figure 5, which used Wilcoxon rank sum test. For the t-tests, data distribution was assumed to be normal but this was not formally tested. This is stated in Online Methods section, para 20.
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 #)?	For all t-tests reported in the current study, data distribution was assumed to be normal but this was not formally tested. This is stated in Online Methods section, para 20.
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 #)?	Not applicable
d. Are tests specified as one- or two-sided?	Yes, all t-tests were two-tailed.
e. Are there adjustments for multiple comparisons?	Not applicable
3. Are criteria for excluding data points reported? Was this criterion established prior to data collection? Where is this described (section, paragraph #)?	Subjects were excluded if data was contaminated by artifacts (tSNR<100). The exclusion criteria were established prior to data collection. Two subjects were excluded in Dataset I. The exclusion details was described in Online Methods section, para 2
4. 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 #)?	Within each dataset, no randomization or blinding was employed. This is because subjects were not divided into groups excepted for dataset III 52 left handed subjects were matched to 52 right handed subjects. This is stated in Online Methods section, para 20.

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5. 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 #)?	Within each dataset, no randomization or blinding was employed. This is stated in Online Methods section, para 20.
6. For experiments in live vertebrates, is a statement of compliance with ethical guidelines/regulations included? Where (section, paragraph #)?	Not applicable
7. Is the species of the animals used reported? Where (section, paragraph #)?	Not applicable
8. Is the strain of the animals (including background strains of KO/ transgenic animals used) reported? Where (section, paragraph #)?	Not applicable
9. Is the sex of the animals/subjects used reported? Where (section, paragraph #)?	Not applicable
10. Is the age of the animals/subjects reported? Where (section, paragraph #)?	Not applicable
11. For animals housed in a vivarium, is the light/dark cycle reported? Where (section, paragraph #)?	Not applicable
12. For animals housed in a vivarium, is the housing group (i.e. number of animals per cage) reported? Where (section, paragraph #)?	Not applicable
13. For behavioral experiments, is the time of day reported (e.g. light or dark cycle)? Where (section, paragraph #)?	Not applicable
14. Is the previous history of the animals/subjects (e.g. prior drug administration, surgery, behavioral testing) reported? Where (section, paragraph #)?	Not applicable
a. If multiple behavioral tests were conducted in the same group of animals, is this reported? Where (section, paragraph #)?	
15. If any animals/subjects were excluded from analysis, is this reported? Where (section, paragraph #)?	Online Methods section, para 2

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a. How were the criteria for exclusion defined?

Where is this described (section, paragraph #)?

For dataset I, subjects were excluded if data was contaminated by artifacts (tSNR<100).

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 #)?

Not applicable

Reagents

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

Not applicable

a. Is antibody catalog number given?

Where does this appear (section, paragraph #)?

Not applicable

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

Where does this appear (section, paragraph #)?

Not applicable

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 #)?

Not applicable

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.

Not applicable

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 #)?

Not applicable

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Data deposition

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.

1. Are accession codes for deposit dates provided? Where (section, paragraph #)?	Not applicable

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.	
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.	The code of the iterative parcellation algorithm is available from the corresponding authors upon request.

Human subjects

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1. Which IRB approved the protocol? Where is this stated (section, paragraph #)?	For the first dataset, participants provided written informed consent in accordance with guidelines set by the institutional review boards of Xuanwu Hospital. The second dataset were publicly available through the NIH Human Connectome Project. Written informed consent was obtained from each participant in accordance with relevant guidelines and regulations approved by the local institutional review board at Washington University in St. Louis (IRB # 201204036). The third dataset were from the Brain Genomics Superstruct Project. All participants provided written informed consent in accordance with guidelines set by Institutional Review Boards of Harvard University or Partners Healthcare. For the fourth dataset, written consent was obtained from each patient or their guardians and the experiments were approved by the Ethics Committees of the Second Affiliated Hospital of Tsinghua University. This is clearly stated in Online Methods Section, paragraph 2,3,5,6
2. Is demographic information on all subjects provided? Where (section, paragraph #)?	Yes. The demographic information is clearly stated for each dataset, in Online Methods section, para 2, 3,5,6 and Supplementary Table 1
3. Is the number of human subjects, their age and sex clearly defined? Where (section, paragraph #)?	Yes. The number of subjects, age and sex are clearly stated for each dataset, in Online Methods section, para 2, 3,5,6 and Supplementary Table 1
4. Are the inclusion and exclusion criteria (if any) clearly specified? Where (section, paragraph #)?	For dataset I, subjects were excluded if data was contaminated by artifacts (tSNR<100). The exclusion criteria is clearly stated in Online Methods section, para 2
5. How well were the groups matched? Where is this information described (section, paragraph #)?	The two groups in Dataset III were matched for age, education, sex, number of runs, data quality, scanner, console, coil, ethnicity (5 Hispanic subjects in each group), and investigator. The information is described in Supplementary Table 1.
6. Is a statement included confirming that informed consent was obtained from all subjects? Where (section, paragraph #)?	Yes, it is clearly stated that informed consent was obtained from all subjects, in Online Methods section, para 2,3,5,6.
7. For publication of patient photos, is a statement included confirming that consent to publish was obtained? Where (section, paragraph #)?	Not applicable

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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?	Yes
a. If yes, is the number rejected and reasons for rejection described? Where (section, paragraph #)?	In dataset I, subjects were excluded if data was contaminated by artifacts (tSNR<100). The exclusion criteria were established according to previous publications prior to data collection. Two subjects were excluded in dataset I. The exclusion details was described in Online Methods section, para 2
2. Is the number of blocks, trials or experimental units per session and/or subjects specified? Where (section, paragraph #)?	Yes For dataset II, scan length of each task is clearly stated in Online Methods, para 3. Specifics of the experimental design can be found in published HCP documentation (which we cite) and HCP release manual. For dataset IV, number of blocks and scan length of each block are clearly stated in Online Methods, para 7.
3. Is the length of each trial and interval between trials specified?	Yes
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.	Yes, blocked design was used.
5. Is the task design clearly described? Where (section, paragraph #)?	For dataset II, specifics of the experimental design can be found in published HCP documentation (which we cite) and HCP release manual. For dataset IV, participants performed self-paced movement (left hand, right hand, left foot, right foot, or tongue) consistent with standard preoperative mapping paradigms. This is clearly described in Online Methods section, para 7
6. How was behavioral performance measured?	Not applicable
7. Is an ANOVA or factorial design being used?	No
8. For data acquisition, is a whole brain scan used? If not, state area of acquisition.	Yes
a. How was this region determined?	
9. Is the field strength (in Tesla) of the MRI system stated?	Yes
a. Is the pulse sequence type (gradient/spin echo, EPI/spiral) stated?	Yes
b. Are the field-of-view, matrix size, slice thickness, and TE/TR/flip angle clearly stated?	Yes

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10. Are the software and specific parameters (model/functions, smoothing kernel size if applicable, etc.) used for data processing and pre-processing clearly stated?	Yes
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 #)?	Yes Online Methods section, para 10,11
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 #)?	Yes Online Methods section, para 10,11
13. How were anatomical locations determined, e.g., via an automated labeling algorithm (AAL), standardized coordinate database (Talairach daemon), probabilistic atlases, etc.?	All analysis were performed on Freesurfer surface space, reconstructed using FreeSurfer version 4.5.0 Online Methods section, para 10,11
14. Were any additional regressors (behavioral covariates, motion etc) used?	Yes. For functional connectivity analyses, head-motion regression and whole-brain signal regression were performed.
15. Is the contrast construction clearly defined?	Yes
16. Is a mixed/random effects or fixed inference used?	Random effect
a. If fixed effects inference used, is this justified?	
17. Were repeated measures used (multiple measurements per subject)?	Yes
a. If so, are the method to account for within subject correlation and the assumptions made about variance clearly stated?	Yes
18. If the threshold used for inference and visualization in figures varies, is this clearly stated?	Yes
19. Are statistical inferences corrected for multiple comparisons?	No
a. If not, is this labeled as uncorrected?	Yes
20. Are the results based on an ROI (region of interest) analysis?	No
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?	Not applicable

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22. For cluster-wise significance, is the cluster-defining threshold and the corrected significance level defined?	Not applicable

Additional comments

Additional Comments	

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