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Supplementary Figures: 9

Supplementary Tables: 0

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.
- 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 page 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, and 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?	PAGE	EXACT VALUE	DEFINED?	PAGE	REPORTED?	PAGE	EXACT VALUE	PAGE	VALUE	PAGE
example	1a	one-way ANOVA	4	9, 9, 10, 15	mice from at least 3 litters/group	4	error bars are mean +/- SEM	4	p = 0.044	4	F(3, 36) = 2.97	4
example	results, pg 6	unpaired t-test	6	15	slices from 10 mice	6	error bars are mean +/- SEM	6	p = 0.0006	6	t(28) = 2.808	6
+ -	2b, Fig S2 left top	one-sample t-test	7	15	humans	5	mean, SEM	7	p = 0.000014	7	t(14) = 6.5	7
+ -	4b, Fig S2 left bottom	one-sample t-test	9	14	humans	9	mean, SEM	9	p = 0.0018	9	t(13) = 3.9	9
+ -	5c, Fig S4	one-sample t-test	9	14	humans	9	all data points shown in Fig. S4		p = 0.014	9	t(13) = 2.8	9

	TEST USED		n			DESCRIPTIVE STATS (AVERAGE, VARIANCE)		P VALUE		DEGREES OF FREEDOM & F/t/z/R/ETC VALUE	
	FIGURE NUMBER	WHICH TEST?	PAGE	EXACT VALUE	DEFINED?	PAGE	REPORTED?	PAGE	EXACT VALUE	PAGE	VALUE	PAGE
+ -	5d, Fig S4	one-sample t-test	9	14	humans	9	all data points shown in Fig. S4a		p = 0.64	9	t(13) = 0.47	9
+ -	p. 10	one-sample t-test	10	15	humans	5	no		p = 0.0013	10	t(14) = 4.0	10
+ -	p. 10	one-sample t-test	10	14	humans	9	no		p = 0.034	10	t(13) = 2.4	10
+ -	p. 8	one-sample t-test	8	15	humans	5	mean	8	p = 1.2 x 10–9	8	t(14) = 14.1	8
+ -	p. 9	one-sample t-test	9	14	humans	9	mean	9	p = 0.45	9	t(13) = 0.8	9
+ -	p. 41	one-sample t-test	34	15	humans	5	mean	34	p = 2.2 x 10–14	34	t(14) = 31.4	34
+ -	p. 41	one-sample t-test	34	15	humans	5	mean	34	p = 4.5 x 10–8	34	t(14) = -10.6	34
+ -	Fig. S4a–b	paired t-test	10	14	humans	9	all data points shown in Fig. S4a		p = 0.046	9	t(13) = 2.2	9
+ -	Fig. S1	two-sample t-test	24	29	humans	5,9	no		p = 0.03	19	t(27) = 2.3	19
+ -	Fig. S1	two-sample t-test	24	29	humans	5,9	no		p = 0.48	20	t(27) = 0.72	20
+ -	Fig. S8e	one-sample t-test	Fig. S8 legend	15	humans	5	no		p = 3.3x 10–5	Fig. S8 legend	t(14) = 6.0	Fig. S8 legend
+ -	Fig. S8e	one-sample t-test	Fig. S8 legend	15	humans	5	no		p = 0.10	Fig. S8 legend	t(14) = 1.8	Fig. S8 legend
+ -	Fig. S8e	one-sample t-test	Fig. S8 legend	15	humans	5	no		p = 0.00023	Fig. S8 legend	t(14) = 4.9	Fig. S8 legend
+ -	Fig. S8e	one-sample t-test	Fig. S8 legend	15	humans	5	no		p = 0.82	Fig. S8 legend	t(14) = 0.23	Fig. S8 legend
+ -	Fig. S8f	one-sample t-test	Fig. S8 legend	14	humans	9	all data points shown in Fig. S8f	50	p = 0.00020	Fig. S8 legend	t(13) = 5.1	Fig. S8 legend
+ -	Fig. S8f	one-sample t-test	Fig. S8 legend	14	humans	9	all data points shown in Fig. S8f	50	p = 0.00024	Fig. S8 legend	t(13) = -5.0	Fig. S8 legend

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 time s this experiment was successfully repeated and a discussion of any limitations in repeatability?

   If so, on what page(s) is this reported?

   N/A

Statistics and general methods

1. Is there a justification of the sample size? If so, how was it justified? On what page(s)? Even if no sample size calculation was performed, authors should report why the sample size is adequate to measure their effect size.	The sample sizes used are within a standard range in the field. The sample size is adequate because we show a significant effect of both variables of interest in both experiments (though, as we predicted in one case this effect is highly sensitive to the distribution of trials tested).
2. Are statistical tests justified as appropriate for every figure? On what page(s)?	All statistical tests performed in these studies are standard in the field, and have been justified in previous reports.
a. If there is a section summarizing the statistical methods in the methods, is the statistical test for each experiment clearly defined?	Yes. Section 5 of Methods.
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?	We used standard fMRI analysis techniques for our whole-brain GLMs and used one-sample t-tests when beta coefficients were approximately normally distributed. Non-parametric tests (Wilcoxon signed-rank test, Supp Figs. 1 and 8, and Spearman's rho, p. 8, 9, 34) were used when data were distributed or correlated non-linearly.
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?	Within-group estimates of variance are included when relevant. A few between-group observations are mentioned in Section 2 of Methods and these are all robust to correction for unequal variances.
d. Are tests specified as one- or two-sided?	All tests are two-sided, with the exception of whole-brain voxelwise p-values which are, by convention, one-sided because they are directional contrasts
e. Are there adjustments for multiple comparisons?	Statistical inference focuses on a single region of interest so no explicit corrections are performed for multiple comparison. See response to #21 in section on 'Human subjects.'
3. Are criteria for excluding data points reported? Was this criterion established prior to data collection? On what page(s) is this described?	Criteria for excluding subjects were all determined a priori and are reported in Section 1 of Methods (see #15 below). The only data points that were excluded from an included participant were from a single trial block from one participant that had completed the session but reported falling asleep during that block (p. 16)
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. On what page(s) does this appear?	N/A. Only one experimental group was used per study.

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, is a statement to this effect included? On what page(s)?	N/A. Only one experimental group was used per study.
6. For experiments in live vertebrates, is a statement of compliance with ethical guidelines/regulations included? On what page(s)?	Yes, in Section 1 of Methods
7. Is the species of the animals used reported? On what page(s)?	Yes (humans). On p. 5.
8. Is the strain of the animals (including background strains of KO/ transgenic animals used) reported? On what page(s)?	N/A
9. Is the sex of the animals/subjects used reported? On what page(s)?	Yes, in Section 1 of Methods
10. Is the age of the animals/subjects reported? On what page(s)?	Yes, in Section 1 of Methods
11. For animals housed in a vivarium, is the light/dark cycle reported? On what page(s)?	N/A
12. For animals housed in a vivarium, is the housing group (i.e. number of animals per cage) reported? On what page(s)?	N/A
13. For behavioral experiments, is the time of day reported (e.g. light or dark cycle)? On what page(s)?	It is not reported explicitly, but all fMRI sessions take place during the day.
14. Is the previous history of the animals/subjects (e.g. prior drug administration, surgery, behavioral testing) reported? On what page(s)?	Subject are reported in Section 1 of Methods to be from a healthy sample (i.e., no history of neurological damage).
a. If multiple behavioral tests were conducted in the same group of animals, is this reported? On what page(s)?	N/A
15. If any animals/subjects were excluded from analysis, is this reported? On what page(s)?	Exclusion criteria were all determined a priori and are reported in Section 1 of Methods

a. How were the criteria for exclusion defined?

Where is this described?

Incomplete sessions (e.g., interruption by scanner malfunction), excessive head movement , misunderstanding of instructions, or failure to meet behavioral criteria defined by the original foraging study.

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

Where is this described?

N/A

Reagents

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

N/A

a. Is antibody catalog number given?

On what page(s) does this appear?

N/A

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

On what page(s) does this appear?

N/A

2. If cell lines were used to reflect the properties of a particular tissue or disease state, is their source identified?

On what page(s)?

N/A

a. Were they recently authenticated?

On what page(s) is this information reported?

N/A

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.

1. Are accession codes for deposit dates provided?

On what page(s)?

N/A

Computer code/software

1. Is there any custom algorithm/software that is integral to the study that has not been previously reported?

   If so, is this algorithm/software provided in a usable and readable form for the referees?

   Indicate in what form this is provided.

All algorithms necessary for review are described and/or cited in Section 4 of Methods. The specific code used for fitting is also available by request.

Human subjects

1. Which IRB approved the protocol?

   Where is this stated?

Princeton University IRB. Stated in Section 1 of Methods.

2. Is demographic information on all subjects provided?

   On what page(s)?

Yes, in Section 1 of Methods.

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

   On what page(s)?

Yes, in Section 1 of Methods.

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

   On what page(s)?

Yes, in Section 1 of Methods.

5. How well were the groups matched?

   Where is this information described?

N/A

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

   On what page(s)?

Yes, in Section 1 of Methods.

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

   On what page(s)?

N/A

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 (see response #3 in section 'Statistics and General Methods')

a. If yes, is the number rejected and reasons for rejection described? On what page(s)?	In Section 1 of Methods.
2. Is the number of blocks, trials or experimental units per session and/or subjects specified? On what page(s)?	Yes, in Section 2 of Methods.
3. Is the length of each trial and interval between trials specified?	Yes, in Section 2 of Methods.
4. Is a blocked design used? If so, is length of blocks specified?	No.
5. Is an event-related design being used? If so, how was the design optimized?	Yes. The design was optimized using jittered Poisson-distributed ITIs (replicating a design previously published by Kolling et al., 2012).
6. Is the task design clearly described? Where?	Yes, on pp. 5, Section 2 of Methods and Fig. 1.
7. How was behavioral performance measured?	With an MR-compatible response box and Matlab's Psychtoolbox (Section 2 of Methods).
8. Are any planned comparisons being used?	Yes
a. Are they clearly described?	Yes
b. Is an ANOVA used?	No
9. For data acquisition, is a whole brain scan used? If not, state area of acquisition.	Yes
a. How was this region determined?	N/A
10. Is the field strength (in Tesla) of the MRI system stated?	Yes (Section 3 of Methods).
a. Is the pulse sequence type (gradient/spin echo, EPI/spiral) stated?	Yes (Section 3 of Methods).
11. Is the software used for data processing and pre-processing clearly stated?	Yes (Section 5 of Methods).
12. For any anatomical imaging, is the coordinate space defined?	Yes (MNI)
13. How was the brain image template space, name, modality and resolution determined?	We used the standard MNI template

14. How were anatomical locations determined?	Coordinates were described in MNI space
15. Is the statistical model and estimation method clearly described?	Yes (Section 5 of Methods).
16. Were any additional regressors (behavioral covariates, motion etc) used?	Model-based parametric regressors were included. All are specified in Section 5 of Methods.
17. Is the contrast construction clearly defined?	Yes (Section 5 of Methods).
18. Is a mixed/random effects or fixed inference used?	Random effects analysis
a. If fixed effects inference used, is this justified?	N/A
19. 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?	The assumptions are not explicitly stated, but the methods of accounting for within-subject correlation are implicit to the standard random-effects GLM approach used.
20. If the threshold used for inference and visualization in figures varies, is this clearly stated?	Yes, differences in thresholds across figures are indicated explicitly.
21. Are statistical inferences corrected for multiple comparisons?	Primary inference was based on ROI analysis within a single ROI (see below). Because of our interest in the dACC alone, exploratory analyses used to identify this ROI and visualize results in the vicinity of the dACC are shown at voxelwise uncorrected p<0.01 - the voxelwise threshold used for Kolling et al.'s (2012) foraging study - with a cluster-defining threshold (200 voxels) that is relatively conservative given our limited anatomical focus. Additional analyses not included in the manuscript confirmed that the activation cluster from Expt 1 used to generate our ROI (Fig. 3a) is robust to cluster-wise multiple comparisons correction at the whole-brain level. Type I Error was further avoided through replication across datasets.
a. If not, is this labeled as uncorrected?	Yes (Section 5 of Methods)
22. Are the results based on an ROI (region of interest) analysis?	Yes
a. If so, is the rationale clearly described?	Yes
b. How were the ROI's defined (functional vs anatomical localization)?	Functionally, based on a peak activation in our first experiment within the anterior cingulate region (Fig. 3a), which itself replicated a previous study finding.
23. Is there correction for multiple comparisons within each voxel?	No (see #21 above)
24. For cluster-wise significance, is the cluster-defining threshold and the corrected significance level defined?	N/A

Additional comments

Additional Comments	