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Main Figures: 2

Supplementary Figures: 6

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 (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
+ -	1b	rANOVA	Page 2, 1st para	6	Human participants	Methods, 1st para	Error bars denote ±1 s.e.m.	Fig legend	p = 0.0012	Page 2, 1st para	F(4,40)=5.51	Page 2, 1st para

		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 #
+ -	1c	rANOVA	Page 3, 1st para	6	Human participants	Methods, 1st para	Error bars denote ±1 s.e.m.	Fig legend	p=.38	Page 3, 1st para	F(4,40)=0.38	Page 3, 1st para
+ -	2b	ttest	Page 3, 2nd para	4	Human participants	Methods, 1st para	Error bars denote ±1 s.e.m.	Fig legend	LGN: p=.0035 V1: p=.0024	Page 3, 2nd para	LGN: t(1,3)=6.65 V1: t(1,3)=7.53	Page 3, 2nd para
+ -	2d	ttest	Page 4, 1st para	4	Human participants	Methods, 1st para	Error bars denote ±1 s.e.m.	Fig legend	LGN: p=.0025 V1: p=.013	Page 4, 1st para	LGN: t(1,3)=7.44 V1: t(1,3)=4.11	Page 4, 1st para

Representative figures

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

   If so, what figure(s)?

N/A

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 #)?

N/A

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.

A power calculation revealed that 6 subjects would be sufficient to detect the predicted interaction of decoding and attention effects. Indeed, this sample size is consistent with previous fMRI decoding studies in our lab (e.g. Harrison & Tong, 2009; Jehee, Brady & Tong, 2011; Pratte et al, 2013). Moreover, our permutation test revealed a significant pattern effects for almost all subjects and conditions in the LGN (21/24 cases), with the exception of three cases in the oblique unattended conditions, which is consistent with our original theoretical prediction. In the additional experiments (radial bias and orientation-tuned masking), because we were testing for main effects, rather than interactions, the sample size was lower (N=4). We have also included plots in the supplementary materials for those two experiments for individual subjects, revealing that the pattern of effects was consistent within every subject.

2. Are statistical tests justified as appropriate for every figure?

   Where (section, paragraph #)?

Yes, the statistics supporting the main interaction depicted in Figure 1 (rANOVA) are described in the first paragraph of Page 2 and the second paragraph of Page 3. The statistics supporting the effects in Figure 2 (ttests) are described in on page 3 (2nd paragraph) and 4 (1st paragraph).

a. If there is a section summarizing the statistical methods in the methods, is the statistical test for each experiment clearly defined?

The tests used are standard (repeated-measures ANOVA, two-sided t-tests), and are evident from the reported statistics. We also describe the tests used in the 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 (section, paragraph #)?

The data considered in our statistical analyses are classification accuracy scores that have been converted to the d' scale. The binomially distributed accuracy score and signal detection theory transformation ensure that these data meet the assumptions of ANOVA and t-tests when the number of trials is sufficiently large (e.g., greater than 20 per subject per condition). We have no fewer than 200 trials that comprise each subject by condition score. To be completely sure that our results did not rely on these assumptions, we performed additional non-parameteric permutation tests to show that classification performance was above chance on an individual-subject level.

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 #)?

The variance within each group of data is depicted in the standard error bars in Figures 1 and 2, and are similar across conditions.

d. Are tests specified as one- or two-sided?

All tests are two-sided.

e. Are there adjustments for multiple comparisons?

We do not have issues of multiple comparisons. In our main analysis, we conducted an ANOVA with planned comparisons targeted towards the interaction of interest.

3. Are criteria for excluding data points reported?

Was this criterion established prior to data collection?

Where is this described (section, paragraph #)?

There was no exclusion of data points in this study.

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 #)?

The ordering of scan conditions was counterbalanced across subjects. This is stated in the Methods (Page 2, Stimulus & Design, 2nd Paragraph).

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 #)?

Although all conditions were counterbalanced, no blinding was done during the experiment. This is stated in the Methods (Page 2, Stimuli & Design).

6. For experiments in live vertebrates, is a statement of compliance with ethical guidelines/regulations included?

Where (section, paragraph #)?

N/A

7. Is the species of the animals used reported?

Where (section, paragraph #)?

N/A

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

   Where (section, paragraph #)?

   N/A

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

   Where (section, paragraph #)?

   N/A

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

    Where (section, paragraph #)?

    The age range of the human participants is reported in the Methods (Page 1, Observers)

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

    Where (section, paragraph #)?

    N/A

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

    Where (section, paragraph #)?

    N/A

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

    Where (section, paragraph #)?

    N/A

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

    Where (section, paragraph #)?

    N/A

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

       Where (section, paragraph #)?

       N/A

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

    Where (section, paragraph #)?

    No subjects were excluded from analysis.

    a. How were the criteria for exclusion defined?

       Where is this described (section, paragraph #)?

       N/A

    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 #)?

       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?

      Where does this appear (section, paragraph #)?

      N/A

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

      Where does this appear (section, paragraph #)?

      N/A

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

   Where (section, paragraph #)?

   N/A

   a. Were they recently authenticated?

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

      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?

   Where (section, paragraph #)?

   N/A

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.

   No custom software was developed to analyze the data. All analyses used standard, readily-available software packages,

2. Is computer source code/software provided with the paper or deposited in a public repository? Indicate in what form this is provided or how it can be obtained.

   N/A

Human subjects

1. Which IRB approved the protocol? Where is this stated (section, paragraph #)?	The Vanderbilt University IRB approved the protocol. This is stated in the Methods (Page 1, Observers)
2. Is demographic information on all subjects provided? Where (section, paragraph #)?	The demographic is not provided, but is unlikely to bear relevance in our study of visual perception.
3. Is the number of human subjects, their age and sex clearly defined? Where (section, paragraph #)?	The #, age & sex are stated in the Methods (Page 1, Observers)
4. Are the inclusion and exclusion criteria (if any) clearly specified? Where (section, paragraph #)?	The exclusion criteria used for participation in our MRI study are described in the Methods (Page 1, Observers)
5. How well were the groups matched? Where is this information described (section, paragraph #)?	The groups were matched in sex, which is described in Methods (Page 1, Observers)
6. Is a statement included confirming that informed consent was obtained from all subjects? Where (section, paragraph #)?	Yes, informed consent was obtained. This is stated in the Methods (Page 1, Observers)
7. For publication of patient photos, is a statement included confirming that consent to publish was obtained? Where (section, paragraph #)?	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?	No subjects were scanned but then rejected.
a. If yes, is the number rejected and reasons for rejection described? Where (section, paragraph #)?	N/A
2. Is the number of blocks, trials or experimental units per session and/or subjects specified? Where (section, paragraph #)?	This is described in the Methods (Page 1, Observers & Page 2, Stimuli and design).
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.	Block design was used, with 16 second blocks. This is described in the Methods.
5. Is the task design clearly described? Where (section, paragraph #)?	The task design is detailed in the Methods (Page 2, Stimuli and design).
6. How was behavioral performance measured?	Behavioral performance (response accuracy) was measured via button-box presses during the scan.
7. Is an ANOVA or factorial design being used?	A repeated-measures ANOVA is used.
8. For data acquisition, is a whole brain scan used? If not, state area of acquisition.	Twenty slices were acquired axially, with through-plane coverage of the thalamus and the occipital pole. This was the maximum allowable coverage for our voxel size (2 mm isotropic) that would cover both the LGN as well as visual cortex.
a. How was this region determined?	This region was determined anatomically, using the pons and corpus callosum as lower and upper bounds, respectively, for slice placement
9. Is the field strength (in Tesla) of the MRI system stated?	Yes, the EPI's were collected at 3 Tesla, and the PD's were at 7 Tesla.
a. Is the pulse sequence type (gradient/spin echo, EPI/spiral) stated?	Yes, we state in the Methods that we used gradient-echo T2*-weighted EPI.
b. Are the field-of-view, matrix size, slice thickness, and TE/TR/ flip angle clearly stated?	Yes, this is stated in the Methods. Functional scans: TR 2 s, TE 35 ms; flip angle 79°; FOV 192 x 192 mm.
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, the steps in analyses are detailed in the Methods.
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 #)?	The analyses remained in subject/native space. This is stated in the Methods (Page 2, fMRI analyses)
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 #)?	The images were not transformed to a standard/normal space; analyses were conducted on ROI's defined from each individual subject in their own space.
13. How were anatomical locations determined, e.g., via an automated labeling algorithm (AAL), standardized coordinate database (Talairach daemon), probabilistic atlases, etc.?	Anatomical locations were identified with a combination of functional localizer and structural delineation. This is described in the Methods (Page 2, fMRI analyses)
14. Were any additional regressors (behavioral covariates, motion etc) used?	No additional regressors were used other than the stimulus events/ conditions, and baseline regressors per scan.
15. Is the contrast construction clearly defined?	N/A

16. Is a mixed/random effects or fixed inference used?	Random effects were used.
a. If fixed effects inference used, is this justified?	N/A
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?	The interaction was tested with a repeated-measures ANOVA, which is stated in the Methods.
18. If the threshold used for inference and visualization in figures varies, is this clearly stated?	Yes, the visualization threshold for the functional localizer is stated in the Methods.
19. Are statistical inferences corrected for multiple comparisons?	We do not have issues of multiple comparisons. In our main analysis, we conducted an ANOVA with planned comparisons targeted towards the interaction of interest.
a. If not, is this labeled as uncorrected?	N/A
20. Are the results based on an ROI (region of interest) analysis?	Yes
a. If so, is the rationale clearly described?	Yes, we detail the criteria used for delineation of the LGN and V1, which are both standard approaches.
b. How were the ROI's defined (functional vs anatomical localization)?	Anatomical locations were identified with a combination of functional localizer and structural delineation. This is described in the Methods (Page 2, fMRI analyses)
21. Is there correction for multiple comparisons within each voxel?	No
22. For cluster-wise significance, is the cluster-defining threshold and the corrected significance level defined?	N/A

Additional comments

Additional Comments	