Cortical surface-based meta-analysis of human visuotopic regions from published stereotaxic coordinates

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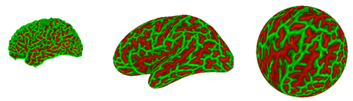
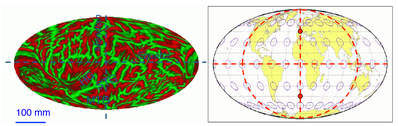
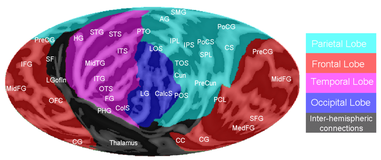
Cortical surface mapping



Mollweide (MW) Projection



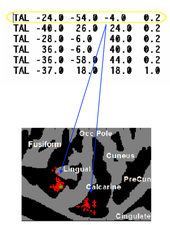


Mapping a stereotaxic location to the cortical surface

Stereotaxic coordinates in text files are processed in Matlab. An occipital lobe Talairach coordinate is circled.

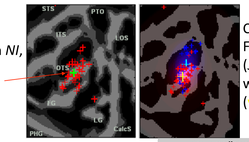
The MNI to cortical surface maps are used to locate the closest location on all 60 surfaces (red) for each coordinate.

The 2D median location of the 60 surface locations is identified (green) and used for further processing.



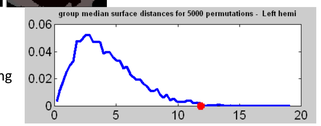
Meta-analyzing the location of two groups of points on the cortex

Compiled FFA coordinates (Berman *NI*, 2010) [1] in red with green as centroid of whole group.



Compared to Visual Word Form Area coordinates (Jobard, *NI*, 2003) [2] in blue, with cyan as group centroid (yellow for FFA).

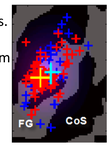
Test if the inter-group surface distance in mm between centroids (*) is high compared to distances (---) after permuting group membership.

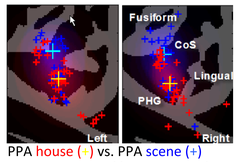


Localizer Contrast Variations

The specific localizer used may matter.

FFA passive viewing (+) vs. FFA task-engaged (+) groups separated by 6 mm and d' =0.5 in the left hemisphere (only 3 mm and d' =0.3 in RH).





PPA house (+) vs. PPA scene (+) groups separated by 15 mm and d' =0.9 in both hemispheres

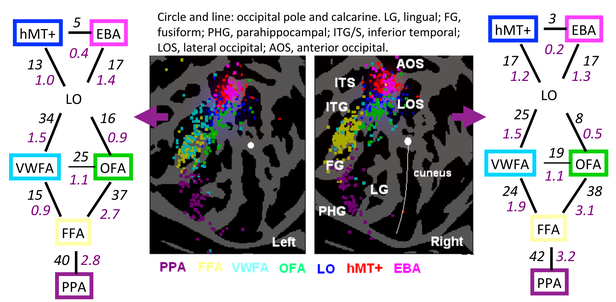
However, the following localizer differences appear to be inconsequential:

FFA: If the foil to faces was objects or scrambled faces (d' =0.2-0.3).
FFA&PPA: How many categories of foil objects were used (d' =0.1-0.2).
OFA&PPA: If subjects were passively viewing or doing a task (d' =0.1-0.3).

Mapping Ventral Extrastriate Visual Stimulus Selective Regions

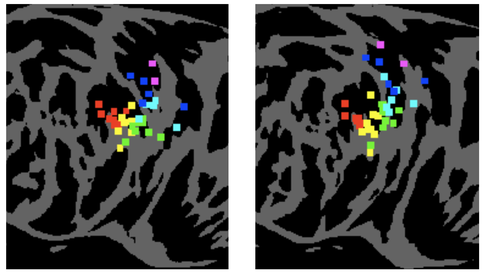
SSR	Papers	Experiments	Coordinates	Subjects
FFA: face vs --- (fusiform)	153	165	283	2068
PPA: place/scene/house vs. ---	57	64	140	789
VWFA: visual words vs ---	58	60	109	762
hMT+: motion vs stationary	80	84	160	949
LO: objects vs scrambled	72	73	142	843
EBA: headless bodies vs ---	28	32	66	431
OFA: face vs --- (occipital)	60	64	111	835

Papers were searched within Google Scholar using the "localizer" keyword along with relevant anatomical and stimulus terms.



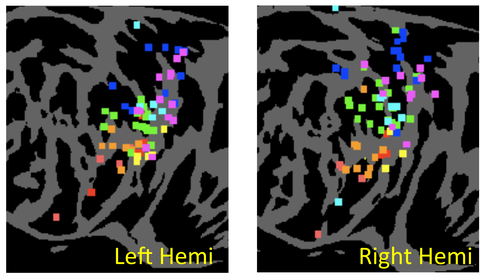
Distances in mm between SSR centroids; robust d' overlap measures in ~ mean/std dev units.

Comparison of different sets of parietal regions



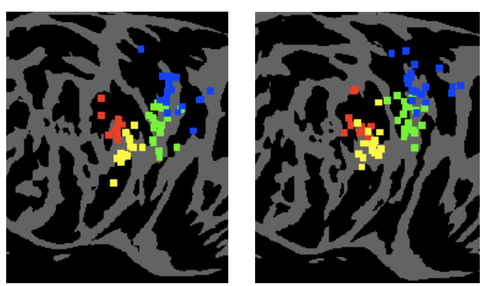
Saccade/attention IPS regions

IPS0 IPS2 IPS4
IPS1 IPS3 IPS5



Human homologs of macaque regions

PO V6a cIPS VIP
V6 PRR LIP MIP



Leuven group motion/depth regions

VIPS DIPSA
POIPS DIPSM

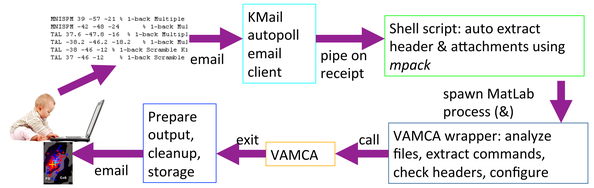
Abstract

INTRODUCTION: Maps of human visual cortex have become crowded with functionally-defined regions of interest (ROIs) Many of these neuroimaging ROIs overlap, in part because research groups studying different aspects of vision assign different names to similar brain regions. We applied a novel atlas-based meta-analysis to the problem of localizing published activation coordinates to cortical surface anatomy. This permitted us to quantify the distinctions and commonalities among visual ROIs from diverse lines of research (retinotopy, category specificity and control of action). METHODS: The MatLab toolbox VAMCA (Visualization And Meta-analysis on Cortical Anatomy) provides surface-based localization of cortical functional activations published as stereotaxic coordinates (nitrc.org/projects/vamca). VAMCA uses a database of cortices from 60 healthy subjects to locate activations on a standardized cortical surface by extending the technique of multi-fiducial mapping. Non-parametric statistical tests are provided for determining the extent of overlap of the two groups' foci. Here we used 55,000+ systematically collected coordinates from 6 journals in the SumsDB database (sumsdb.wustl.edu/sums) as well as ROI localizer coordinates from other articles to verify how accurately a wide gamut of anatomically-labelled functional contrasts are mapped to cortex. RESULTS: Most pairs of ventral cortex ROIs were reliably distinct from each other, including FFA and the visual word form area (VWFA). However, we did find significant separation between house- vs. scene-defined versions of the parahippocampal place area (PPA). Among dorsal ROIs, we identified several cases in which ROIs from different lines of research were likely to represent the same functional region; for example the human homologs of macaque LIP, DIPSM and the saccade-defined IPS3 region. CONCLUSION: We illustrate the position of over 20 functional ROIs and the statistical reliability of their locations on the cortical surface. We hope that this meta-analysis will clarify understanding of the functional organization of human visual cortex anatomy.

VAMCA Email Service

VAMCA.hcnlab@ebire.org hosts a VAMCA meta-analysis service. Text files with stereotaxic coordinates as attachments or in the email body are processed and returned with output text files and graphics.

System configuration is simple and extensible:



Acknowledgements

We would like to thank Kimmo Alho for ideas and encouragement and And Turken and Bill Yund for many discussions.

This work is supported by the VA Research Service through RR&D grant (B6120R,Woods).

References

[1] Berman et al, NI, 50, 2010
[2] Jobard et al, NI, 20, 2003.