<html> <html xmlns="http://www.w3.org/1999/xhtml"><head><meta http-equiv="Content-Type" content="text/html; charset=UTF-8"><title>Zotero Report</title><link rel="stylesheet" type="text/css" href="Zotero%20Report_retinotopy_stimulus_methods_files/detail.css"><link rel="stylesheet" type="text/css" media="screen,projection" href="Zotero%20Report_retinotopy_stimulus_methods_files/detail_screen.css"><link rel="stylesheet" type="text/css" media="print" href="Zotero%20Report_retinotopy_stimulus_methods_files/detail_print.css"></head><body><ul class="report combineChildItems"><li id="item-21488" class="item journalArticle"><h2>*Borders, map clusters, and supra-areal organization in visual cortex*</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Randy L. Buckner</td></tr><tr class="creator author"><th class="author">Author</th><td>B. T. Thomas Yeo</td></tr><tr class="url"><th class="url">URL</th><td>*http://www.sciencedirect.com/science/article/pii/S1053811913012561*</td></tr><tr class="volume"><th class="volume">Volume</th><td>93, Part 2</td></tr><tr class="pages"><th class="pages">Pages</th><td>292-297</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>NeuroImage</td></tr><tr class="date"><th class="date">Date</th><td>June 2014</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>*10.1016/j.neuroimage.2013.12.036*</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>*V1 is a canonical cortical area with clearly delineated architectonic boundaries and a continuous topographic representation of the visual hemifield. It thus serves as a touchstone for understanding what new mapping methods can tell us about cortical organization. By parcellating human cortex using local gradients in functional connectivity, Wig et al. (2014–in this issue) detected the V1 border with V2. By contrast, previously-published clustering methods that focus on global similarity in connectivity reveal a supra-areal organization that emphasizes eccentricity bands spanning V1 and its neighboring extrastriate areas; i.e. in the latter analysis, the V1 border is not evident. Thus the focus on local connectivity gradients emphasizes qualitatively different features of cortical organization than are captured by global similarity measures. What is intriguing to consider is that each kind of information might be telling us something unique about cortical organization. Global similarity measures may be detecting map clusters and other supra-areal arrangements that reflect a fundamental level of organization.*</td></tr></tbody></table>
<li *id="item-12506" class="item journalArticle"><h2>Retinotopic organization in children measured with fMRI</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Ian P. Conner</td></tr><tr class="creator author"><th class="author">Author</th><td>Saloni Sharma</td></tr><tr class="creator author"><th class="author">Author</th><td>Susan K. Lemieux</td></tr><tr class="creator author"><th class="author">Author</th><td>Janine D. Mendola</td></tr><tr class="url"><th class="url">URL</th><td>http://www.journalofvision.org/content/4/6/10</td></tr><tr class="volume"><th class="volume">Volume</th><td>4</td></tr><tr class="issue"><th class="issue">Issue</th><td>6</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Journal of Vision</td></tr><tr class="date"><th class="date">Date</th><td>06/18/2004</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1167/4.6.10</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>Many measures of visual function reach adult levels by about

age 5, but some visual abilities continue to develop throughout adolescence. Little is known about the underlying functional anatomy of visual cortex in human infants or children. We used fMRI to measure the retinotopic organization of visual cortex in 15 children aged 7–12 years. Overall, we obtained adult-like patterns for most children tested. We found that significant head motion accounted for poor quality maps in a few tested children who were excluded from further analysis. When the maps from 10 children were compared with those obtained from 10 adults, the magnitude of retinotopic signals in visual areas V1, V2, V3, V3A, VP, and V4v was essentially the same between children and adults. Furthermore, one measure of intra-area organization, the cortical magnification function, did not significantly differ between adults and children for V1 or V2. However, quantitative analysis of visual area size revealed some significant differences beyond V1. Adults had larger extrastriate areas (V2, V3, VP, and V4v), when measured absolutely or as a proportion of the entire cortical sheet. We found that the extent and laterality of retinotopic signals beyond these classically defined areas, in parietal and lateral occipital cortex, showed some differences between adults and children. These data serve as a useful reference for studies of higher cognitive function in pediatric populations and for studies of children with vision disorders, such as amblyopia.</td></tr></tbody></table>
<li id="item-15395" class="item journalArticle"><h2>The development and use of phase-encoded functional MRI designs</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Stephen A Engel</td></tr><tr class="volume"><th class="volume">Volume</th><td>62</td></tr><tr class="issue"><th class="issue">Issue</th><td>2</td></tr><tr class="pages"><th class="pages">Pages</th><td>1195-1200</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>NeuroImage</td></tr><tr class="date"><th class="date">Date</th><td>Aug 15, 2012</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1016/j.neuroimage.2011.09.059</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>Phase-encoded designs advanced the early development of functional MRI, enabling the "killer app" of retinotopic mapping, which helped demonstrate fMRI's value to a skeptical scientific public. The design, also called "the traveling wave", remains in wide use today, due to its ability to easily measure neural activity in a parameterized set of experimental conditions. In phase-encoded designs, stimuli defined by a numerical parameter, for example visual eccentricity, are presented continuously in the order specified by the parameter. The stimulus parameter that produces maximum response can be recovered from the timing of neural activity, i.e. its phase. From the outset, phase-encoded designs were used for two related, but complementary purposes: 1) to measure aggregate response properties of neurons in a voxel, for example the average visual field location of receptive fields, and 2) to segregate the set of voxels that corresponds to an organized cortical region, for example a retinotopically mapped visual area. This short review will cover the history and current uses of phase-encoded fMRI, while noting the ongoing tension in the field between the brain mapping and computational neuroimaging approaches.</td></tr></tbody></table>
<li id="item-10280" class="item journalArticle"><h2>Retinotopic Maps, Spatial Tuning, and Locations of Human Visual Areas in Surface Coordinates Characterized with Multifocal and Blocked fMRI Designs</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Linda Henriksson</td></tr><tr class="creator author"><th class="author">Author</th><td>Juha Karvonen</td></tr><tr class="creator author"><th class="author">Author</th><td>Niina Salminen-Vaparanta</td></tr><tr class="creator author"><th class="author">Author</th><td>Henry Railo</td></tr><tr class="creator author"><th class="author">Author</th><td>Simo Vanni</td></tr><tr class="url"><th

class="url">URL</th><td>http://dx.doi.org/10.1371/journal.pone.0036859</td></tr><tr class="volume"><th class="volume">Volume</th><td>7</td></tr><tr class="issue"><th class="issue">Issue</th><td>5</td></tr><tr class="pages"><th class="pages">Pages</th><td>e36859</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>PLoS ONE</td></tr><tr class="date"><th class="date">Date</th><td>May 9, 2012</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1371/journal.pone.0036859</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>The localization of visual areas in the human cortex is typically based on mapping the retinotopic organization with functional magnetic resonance imaging (fMRI). The most common approach is to encode the response phase for a slowly moving visual stimulus and to present the result on an individual's reconstructed cortical surface. The main aims of this study were to develop complementary general linear model (GLM)-based retinotopic mapping methods and to characterize the inter-individual variability of the visual area positions on the cortical surface. We studied 15 subjects with two methods: a 24-region multifocal checkerboard stimulus and a blocked presentation of object stimuli at different visual field locations. The retinotopic maps were based on weighted averaging of the GLM parameter estimates for the stimulus regions. In addition to localizing visual areas, both methods could be used to localize multiple retinotopic regions-of-interest. The two methods yielded consistent retinotopic maps in the visual areas V1, V2, V3, hV4, and V3AB. In the higher-level areas IPS0, VO1, LO1, LO2, TO1, and TO2, retinotopy could only be mapped with the blocked stimulus presentation. The gradual widening of spatial tuning and an increase in the responses to stimuli in the ipsilateral visual field along the hierarchy of visual areas likely reflected the increase in the average receptive field size. Finally, after registration to Freesurfer's surface-based atlas of the human cerebral cortex, we calculated the mean and variability of the visual area positions in the spherical surface-based coordinate system and generated probability maps of the visual areas on the average cortical surface. The inter-individual variability in the area locations decreased when the midpoints were calculated along the spherical cortical surface compared with volumetric coordinates. These results can facilitate both analysis of individual functional anatomy and comparisons of visual cortex topology across studies.</td></tr></tbody></table>
<li id="item-8514" class="item journalArticle"><h2>*Quantifying spatial uncertainty of visual area boundaries in neuroimaging data*</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Dean Kirson</td></tr><tr class="creator author"><th class="author">Author</th><td>Alexander C Huk</td></tr><tr class="creator author"><th class="author">Author</th><td>Lawrence K Cormack</td></tr><tr class="url"><th class="url">URL</th><td>http://www.ncbi.nlm.nih.gov/pubmed/19146352</td></tr><tr class="volume"><th class="volume">Volume</th><td>8</td></tr><tr class="issue"><th class="issue">Issue</th><td>10</td></tr><tr class="pages"><th class="pages">Pages</th><td>10.1-15</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Journal of Vision</td></tr><tr class="date"><th class="date">Date</th><td>2008</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1167/8.10.10</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>*Functional magnetic resonance imaging (fMRI) of the human brain has provided much information about visual cortex. These insights hinge on researchers' ability to identify cortical areas based on stimulus selectivity and retinotopic mapping. However, border identification around regions of interest or between retinotopic maps is often performed without characterizing the degree of certainty associated with the location of these key features; ideally,*

*assertions about the location of boundaries would have an associated spatial confidence interval. We describe an approach that allows researchers to transform estimates of error in the intensive dimension (i.e., activation of voxels) to the spatial dimension (i.e., the location of features evident in patterns across voxels). We implement the approach by bootstrapping, with applications to: (1) the location of human MT+ and (2) the location of the V1/V2 boundary. The transformation of intensive to spatial error furnishes graphical, intuitive characterizations of spatial uncertainty akin to error bars on the borders of visual areas, instead of the conventional practice of computing and thresholding p-values for voxels. This approach provides a general, unbiased arena for evaluating: (1) competing conceptions of visual area organization; (2) analysis technique efficacy; and (3) data quality.</td></tr></tbody></table>
<li id="item-22861" class="item journalArticle"><h2>Comparison of randomized multifocal mapping and temporal phase mapping of visual cortex for clinical use</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Yan Ma</td></tr><tr class="creator author"><th class="author">Author</th><td>B. Douglas Ward</td></tr><tr class="creator author"><th class="author">Author</th><td>Kristina M. Ropella</td></tr><tr class="creator author"><th class="author">Author</th><td>Edgar A. DeYoe</td></tr><tr class="url"><th class="url">URL</th><td>http://www.sciencedirect.com/science/article/pii/S2213158213001046</td></tr><tr class="volume"><th class="volume">Volume</th><td>3</td></tr><tr class="pages"><th class="pages">Pages</th><td>143-154</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>NeuroImage: Clinical</td></tr><tr class="date"><th class="date">Date</th><td>2013</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1016/j.nicl.2013.08.004</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>fMRI is becoming an important clinical tool for planning and guidance of surgery to treat brain tumors, arteriovenous malformations, and epileptic foci. For visual cortex mapping, the most popular paradigm by far is temporal phase mapping, although random multifocal stimulation paradigms have drawn increased attention due to their ability to identify complex response fields and their random properties. In this study we directly compared temporal phase and multifocal vision mapping paradigms with respect to clinically relevant factors including: time efficiency, mapping completeness, and the effects of noise. Randomized, multifocal mapping accurately decomposed the response of single voxels to multiple stimulus locations and made correct retinotopic assignments as noise levels increased despite decreasing sensitivity. Also, multifocal mapping became less efficient as the number of stimulus segments (locations) increased from 13 to 25 to 49 and when duty cycle was increased from 25% to 50%. Phase mapping, on the other hand, activated more extrastriate visual areas, was more time efficient in achieving statistically significant responses, and had better sensitivity as noise increased, though with an increase in systematic retinotopic mis-assignments. Overall, temporal phase mapping is likely to be a better choice for routine clinical applications though random multifocal mapping may offer some unique advantages for selected applications.</td></tr></tbody></table>
<li id="item-5668" class="item journalArticle"><h2>How much luxury is there in 'luxury perfusion'? An analysis of the BOLD response in the visual areas V1 and V2</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Valentine L Marcar</td></tr><tr class="creator author"><th class="author">Author</th><td>Thomas Loenneker</td></tr><tr class="creator author"><th class="author">Author</th><td>Andrea Straessle</td></tr><tr class="creator author"><th class="author">Author</th><td>Franck Girard</td></tr><tr class="creator author"><th class="author">Author</th><td>Ernst Martin</td></tr><tr class="url"><th*

class="url">URL</th><td>http://www.ncbi.nlm.nih.gov/pubmed/15288132</td></tr><tr class="volume"><th class="volume">Volume</th><td>22</td></tr><tr class="issue"><th class="issue">Issue</th><td>7</td></tr><tr class="pages"><th class="pages">Pages</th><td>921-928</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Magnetic Resonance Imaging</td></tr><tr class="date"><th class="date">Date</th><td>Sep 2004</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1016/j.mri.2004.02.013</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>We re-analyzed the functional magnetic resonance imaging data from a study involving awake, adult, human volunteers in order to examine the influence of vascular density on the blood oxygenation level-dependent (BOLD) response. We employed a flashed and reversing stimulus paradigm where the latter stimulated twice the number of receptive fields and with it doubled the neuronal metabolic load (CMRO2) compared to the former stimulus. The blood flow increase to these stimuli was identical, so that differences in the BOLD response are due to differences in the oxygen extraction fraction. By comparing the BOLD response in human striate cortex (V1) and its neighbor, extra-striate area V2 to the two stimuli, we were able to determine the influence of the higher vascular density of striate cortex on the BOLD response. In striate cortex, the extent of activation, as measured by the number of activated voxels, was larger for the flashed than for the reversing stimulus. In extra-striate area V2, no such difference in the extent of activation was noted. Gauging the local concentration of HbR using deltaR2, we found it to be significantly lower for the flashed than for the reversing checkerboard. We estimated the HbR concentration in extra-striate area V2 to be double that of striate cortex independent of the stimulus presented. A frequency distribution of the deltaR2* values for the flashed and reversing checkerboard revealed a shift consistent with an increase in the HbR concentration between areas V1 and V2. The metabolically most demanding stimulus, the reversing checkerboard was associated with the highest HbR concentration and with the largest number of voxels with a negative BOLD response.</td></tr></tbody></table>
<li id="item-9273" class="item journalArticle"><h2>Quantitative multifocal fMRI shows active suppression in human V1</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Miika Pihlaja</td></tr><tr class="creator author"><th class="author">Author</th><td>Linda Henriksson</td></tr><tr class="creator author"><th class="author">Author</th><td>Andrew C James</td></tr><tr class="creator author"><th class="author">Author</th><td>Simo Vanni</td></tr><tr class="url"><th class="url">URL</th><td>http://www.ncbi.nlm.nih.gov/pubmed/18381768</td></tr><tr class="volume"><th class="volume">Volume</th><td>29</td></tr><tr class="issue"><th class="issue">Issue</th><td>9</td></tr><tr class="pages"><th class="pages">Pages</th><td>1001-1014</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Human Brain Mapping</td></tr><tr class="date"><th class="date">Date</th><td>Sep 2008</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1002/hbm.20442</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>Multifocal functional magnetic resonance imaging has recently been introduced as an alternative method for retinotopic mapping, and it enables effective functional localization of multiple regions-of-interest in the visual cortex. In this study we characterized interactions in V1 with spatially and temporally identical stimuli presented alone, or as a part of a nine-region multifocal stimulus. We compared stimuli at different contrasts, collinear and orthogonal orientations and spatial frequencies one octave apart. Results show clear attenuation of BOLD

signal from the central region in the multifocal condition. The observed modulation in BOLD signal could be produced either by neural suppression resulting from stimulation of adjacent regions of visual field, or alternatively by hemodynamic saturation or stealing effects in V1. However, we find that attenuation of the central response persists through a range of contrasts, and that its strength varies with relative orientation and spatial frequency of the central and surrounding stimulus regions, indicating active suppression mechanisms of neural origin. Our results also demonstrate that the extent of the signal spreading is commensurate with the extent of the horizontal connections in primate V1.</td></tr></tbody></table>
<li id="item-6110" class="item journalArticle"><h2>*Localizing Retinotopic fMRI Activation in Human Primary Visual Cortex via Dynamic Programming*</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Anqi Qiu</td></tr><tr class="creator author"><th class="author">Author</th><td>Benjamin Rosenau</td></tr><tr class="creator author"><th class="author">Author</th><td>Adam Greenberg</td></tr><tr class="creator author"><th class="author">Author</th><td>Patrick Barta</td></tr><tr class="creator author"><th class="author">Author</th><td>Steven Yantis</td></tr><tr class="creator author"><th class="author">Author</th><td>Michael Miller</td></tr><tr class="url"><th class="url">URL</th><td>*http://www.ncbi.nlm.nih.gov/pubmed/17282437*</td></tr><tr class="volume"><th class="volume">Volume</th><td>2</td></tr><tr class="pages"><th class="pages">Pages</th><td>1313-1316</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>*Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference*</td></tr><tr class="date"><th class="date">Date</th><td>2005</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1109/IEMBS.2005.1616668</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>*This paper presents an approach for automatically delineating the borders of human primary visual cortex and finding ridges of maximal response due to static phase-encoding stimuli on fMRI t-statistical maps via dynamic programming. The sensitivity of such an approach to the choice of initial starting and ending points and the identification of the ridge path over a wide response region are addressed. Moreover, retinotopic maps for left and right visual cortex are shown in a population of two normal subjects.*</td></tr></tbody></table>
<li id="item-8821" class="item journalArticle"><h2>Estimating linear cortical magnification in human primary visual cortex via dynamic programming</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Anqi Qiu</td></tr><tr class="creator author"><th class="author">Author</th><td>Benjamin J Rosenau</td></tr><tr class="creator author"><th class="author">Author</th><td>Adam S Greenberg</td></tr><tr class="creator author"><th class="author">Author</th><td>Monica K Hurdal</td></tr><tr class="creator author"><th class="author">Author</th><td>Patrick Barta</td></tr><tr class="creator author"><th class="author">Author</th><td>Steven Yantis</td></tr><tr class="creator author"><th class="author">Author</th><td>Michael I Miller</td></tr><tr class="volume"><th class="volume">Volume</th><td>31</td></tr><tr class="issue"><th class="issue">Issue</th><td>1</td></tr><tr class="pages"><th class="pages">Pages</th><td>125-38</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>NeuroImage</td></tr><tr class="date"><th class="date">Date</th><td>May 15, 2006</td></tr><tr class="DOI"><th class="DOI">DOI</th><td><a href="http://doi.org/S1053-8119%2805%2902519-

X">S1053-8119(05)02519-X</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>Human primary visual cortex is organized retinotopically, with adjacent locations in cortex representing adjacent locations on the retina. The spatial sampling in cortex is highly nonuniform: the amount of cortex devoted to a unit area of retina decreases with increasing retinal eccentricity. This sampling property can be quantified by the linear cortical magnification factor, which is expressed in terms of millimeters of cortex per degree of visual angle. In this paper, we present a new method using dynamic programming and fMRI retinotopic eccentricity mapping to estimate the linear cortical magnification factor in human primary visual cortex (V1). We localized cortical activity while subjects viewed each of seven stationary contrast- reversing radial checkerboard rings of equal thickness that tiled the visual field from 1.62 to 12.96 degrees of eccentricity. Imaging data from all epochs of each ring were contrasted with data from fixation epochs on a subject-by-subject basis. The resulting t statistic maps were then superimposed on a local coordinate system constructed from the gray/white matter boundary surface of each individual subject's occipital lobe, separately for each ring. Smoothed maps of functional activity on the cortical surface were constructed using orthonormal bases of the Laplace-Beltrami operator that incorporate the geometry of the cortical surface. This allowed us to stably track the ridge of maximum activation due to each ring via dynamic programming optimization over all possible paths on the cortical surface. We estimated the linear cortical magnification factor by calculating geodesic distances between activation ridges on the cortical surface in a population of five normal subjects. The reliability of these estimates was assessed by comparing results based on data from one quadrant to those based on data from the full hemifield along with a split-half reliability analysis.</td></tr></tbody></table>
<li id="item-9194" class="item journalArticle"><h2>*Two-dimensional mapping of the central and parafoveal visual field to human visual cortex*</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Mark M Schira</td></tr><tr class="creator author"><th class="author">Author</th><td>Alex R Wade</td></tr><tr class="creator author"><th class="author">Author</th><td>Christopher W Tyler</td></tr><tr class="volume"><th class="volume">Volume</th><td>97</td></tr><tr class="issue"><th class="issue">Issue</th><td>6</td></tr><tr class="pages"><th class="pages">Pages</th><td>4284-95</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Journal of Neurophysiology</td></tr><tr class="date"><th class="date">Date</th><td>Jun 2007</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>00972.2006</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>*Primate visual cortex contains a set of maps of visual space. These maps are fundamental to early visual processing, yet their form is not fully understood in humans. This is especially true for the central and most important part of the visual field–the fovea. We used functional magnetic resonance imaging (fMRI) to measure the mapping geometry of human V1 and V2 down to 0.5 degrees of eccentricity. By applying automated atlas fitting procedures to parametrize and average retinotopic measurements of eight brains, we provide a reference standard for the two-dimensional geometry of human early visual cortex of unprecedented precision and analyze this high-quality mean dataset with respect to the 2-dimensional cortical magnification morphometry. The analysis indicates that 1) area V1 has meridional isotropy in areal projection: equal areas of visual space are mapped to equal areas of cortex at any given eccentricity. 2) V1 has a systematic pattern of local anisotropies: cortical magnification varies between isopolar and isoeccentricity lines, and 3) the shape of V1 deviates systematically from the complex-log model, the fit of which is particularly poor close to the fovea. We therefore propose that human V1 be fitted by models based on an equal-area principle of its two-dimensional magnification. 4) V2 is elongated by a factor of 2 in eccentricity direction relative to V1 and has significantly more local anisotropy. We propose that V2 has systematic intrinsic curvature, but V1 is intrinsically flat.*</td></tr></tbody></table>
<li

*id="item-15373" class="item journalArticle"><h2>Analysis of retinotopic maps in extrastriate cortex</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>M I Sereno</td></tr><tr class="creator author"><th class="author">Author</th><td>C T McDonald</td></tr><tr class="creator author"><th class="author">Author</th><td>J M Allman</td></tr><tr class="volume"><th class="volume">Volume</th><td>4</td></tr><tr class="issue"><th class="issue">Issue</th><td>6</td></tr><tr class="pages"><th class="pages">Pages</th><td>601-620</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Cerebral cortex (New York, N.Y.: 1991)</td></tr><tr class="date"><th class="date">Date</th><td>1994 Nov-Dec</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>Two new techniques for analyzing retinotopic maps–arrow diagrams and visual field sign maps–are demonstrated with a large electrophysiological mapping data set from owl monkey extrastriate visual cortex. An arrow diagram (vectors indicating receptive field centers placed at cortical coordinates) provides a more compact and understandable representation of retinotopy than does a standard receptive field chart (accompanied by a penetration map) or a double contour map (e.g., isoeccentricity and isopolar angle as a function of cortical x, y-coordinates). None of these three representational techniques, however, make separate areas easily visible, especially in data sets containing numerous areas with partial, distorted representations of the visual hemifield. Therefore, we computed visual field sign maps (non-mirror-image vs mirror-image visual field representation) from the angle between the direction of the cortical gradient in receptive field eccentricity and the cortical gradient in receptive field angle for each small region of the cortex. Visual field sign is a local measure invariant to cortical map orientation and distortion but also to choice of receptive field coordinate system. To estimate the gradients, we first interpolated the eccentricity and polar angle data onto regular grids using a distance-weighted smoothing algorithm. The visual field sign technique provides a more objective method for using retinotopy to outline multiple visual areas. In order to relate these arrow and visual field sign maps accurately to architectonic features visualized in the stained, flattened cortex, we also developed a deformable template algorithm for warping the photograph-derived penetration map using the final observed location of a set of marking lesions.</td></tr></tbody></table>
<li id="item-21465" class="item conferencePaper"><h2>Characterizing human retinotopic mapping with conformal geometry: a preliminary study</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Duyan Ta</td></tr><tr class="creator author"><th class="author">Author</th><td>Jie Shi</td></tr><tr class="creator author"><th class="author">Author</th><td>Brian Barton</td></tr><tr class="creator author"><th class="author">Author</th><td>Alyssa Brewer</td></tr><tr class="creator author"><th class="author">Author</th><td>Zhong-Lin Lu</td></tr><tr class="creator author"><th class="author">Author</th><td>Yalin Wang</td></tr><tr class="url"><th class="url">URL</th><td>http://dx.doi.org/10.1117/12.2043570</td></tr><tr class="volume"><th class="volume">Volume</th><td>9034</td></tr><tr class="pages"><th class="pages">Pages</th><td>90342A-90342A-10</td></tr><tr class="date"><th class="date">Date</th><td>2014</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1117/12.2043570</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>Functional magnetic resonance imaging (fMRI) has been widely used to measure the retinotopic organization of early visual cortex in the human brain. Previous studies have identified multiple visual field maps (VFMs) based on statistical analysis of fMRI signals, but the resulting geometry has not been fully characterized with mathematical

*models. Here we test whether VFMs V1 and V2 obey the least restrictive of all geometric mappings; that is, whether they are anglepreserving and therefore maintain conformal mapping. We measured retinotopic organization in individual subjects using standard traveling-wave fMRI methods. Visual stimuli consisted of black and white, drifting checkerboards comprising rotating wedges and expanding rings to measure the cortical representations of polar angle and eccentricity, respectively. These representations were then projected onto a 3D cortical mesh of each hemisphere. By generating a mapped unit disk that is conformal of the VFMs using spherical stereographic projection and computing the parameterized coordinates of the eccentricity and polar angle gradients, we computed Beltrami coefficients to check whether the mapping from the visual field to the V1 and V2 cortical representations is conformal. We find that V1 and V2 exhibit local conformality. Our analysis of the Beltrami coefficient shows that selected regions of V1 and V2 that contain reasonably smooth eccentricity and polar angle gradients do show significant local conformality, warranting further investigation of this approach for analysis of early and higher visual cortex. These results suggest that such a mathematical model can be used to characterize the early VFMs in human visual cortex.</td></tr></tbody></table>
<li id="item-9242" class="item journalArticle"><h2>fMRI retinotopic mapping at 3 T: Benefits gained from correcting the spatial distortions due to static field inhomogeneity</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Flor Vasseur</td></tr><tr class="creator author"><th class="author">Author</th><td>Chantal Delon-Martin</td></tr><tr class="creator author"><th class="author">Author</th><td>Cécile Bordier</td></tr><tr class="creator author"><th class="author">Author</th><td>Jan Warnking</td></tr><tr class="creator author"><th class="author">Author</th><td>Laurent Lamalle</td></tr><tr class="creator author"><th class="author">Author</th><td>Christoph Segebarth</td></tr><tr class="creator author"><th class="author">Author</th><td>Michel Dojat</td></tr><tr class="url"><th class="url">URL</th><td>http://www.journalofvision.org/content/10/12/30.abstract</td></tr><tr class="volume"><th class="volume">Volume</th><td>10</td></tr><tr class="issue"><th class="issue">Issue</th><td>12</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Journal of Vision</td></tr><tr class="date"><th class="date">Date</th><td>October 25 , 2010</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1167/10.12.30</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>fMRI retinotopic mapping usually relies upon Fourier analysis of functional responses to periodic visual stimuli that encode eccentricity or polar angle in the visual field. Generally, phase estimations are assigned to a surface model of the cerebral cortex and borders between retinotopic areas are eventually determined following ad hoc phase analysis on the surface model. Assigning functional responses to a surface model of the cortex is particularly sensitive to geometric distortions of the 3D functional data due to static field inhomogeneity. Here, we assess and document the benefits gained from correcting the fMRI data for these effects, under standard experimental conditions (echo-planar imaging, 3.0-T field strength) and with well-chosen acquisition parameters (regarding slice orientation and phase-encoding direction). While it appears that, in the absence of correction, errors in the estimates of the borders between low-order visual areas do not then significantly exceed the variance of statistical origin, about half of the functional responses in a retinotopic experiment are misassigned to neighboring functional areas. Therefore, correction of the effects due to geometric distortions is important in any retinotopic mapping experiment and by extension in any fMRI experiment on the visual system.</td></tr></tbody></table>
<li id="item-21466" class="item journalArticle"><h2>*Visual Field Maps of the*

Human Visual Cortex for Central and Peripheral Vision</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Bin Wang</td></tr><tr class="creator author"><th class="author">Author</th><td>Hiroki Yamamoto</td></tr><tr class="creator author"><th class="author">Author</th><td>Jinglong Wu</td></tr><tr class="creator author"><th class="author">Author</th><td>Yoshimichi Ejima</td></tr><tr class="volume"><th class="volume">Volume</th><td>1</td></tr><tr class="issue"><th class="issue">Issue</th><td>2</td></tr><tr class="pages"><th class="pages">Pages</th><td>102-110</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Neuroscience and Biomedical Engineering</td></tr><tr class="date"><th class="date">Date</th><td>2013-09-01T00:00:00/</td></tr><tr class="abstractNote"><th class="abstractNote">Abstract</th><td>In humans, visual information in the peripheral visual field is processed differently from such information in the central visual field. For example, peripheral vision prefers coarser information, while central vision prefers finer details. Recent advances in neuroimaging allowed us to non-invasively explore the neural substrates underlying the distinctiveness of peripheral and central vision. In the human visual cortex, there is a mosaic of orderly representations of the visual field, and this organization is called a visual field map. In this review, we summarize the various strands of research on visual field maps, which are crucial to understand human peripheral vision. We first describe the techniques that are used to measure visual field maps by means of functional magnetic resonance imaging (fMRI). We then review several studies that have tried to locate human visual areas using these techniques. We focused particularly on the findings of retinotopic organization for "far" peripheral visual field and tried to find the cortical regions that are crucial for peripheral vision.</td></tr></tbody></table>
<li id="item-6509" class="item journalArticle"><h2>Development of a wide-view visual presentation system for visual retinotopic mapping during functional MRI</h2><table><tbody><tr class="creator author"><th class="author">Author</th><td>Tianyi Yan</td></tr><tr class="creator author"><th class="author">Author</th><td>Fengzhe Jin</td></tr><tr class="creator author"><th class="author">Author</th><td>Jiping He</td></tr><tr class="creator author"><th class="author">Author</th><td>Jinglong Wu</td></tr><tr class="url"><th class="url">URL</th><td>http://onlinelibrary.wiley.com/doi/10.1002/jmri.22404/abstract</td></tr><tr class="volume"><th class="volume">Volume</th><td>33</td></tr><tr class="issue"><th class="issue">Issue</th><td>2</td></tr><tr class="pages"><th class="pages">Pages</th><td>441-447</td></tr><tr class="publicationTitle"><th class="publicationTitle">Publication</th><td>Journal of Magnetic Resonance Imaging</td></tr><tr class="date"><th class="date">Date</th><td>2011/02/01</td></tr><tr class="DOI"><th class="DOI">DOI</th><td>10.1002/jmri.22404</td></tr></tbody></table>
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Manual</h2><table><tbody><tr class="url"><th class="url">URL</th><td>http://white.stanford.edu/newlm/index.php/Atlas</td></tr></tbody></table>
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