#43.420

Visual cortical architecture in high-functioning autism spectrum disorders

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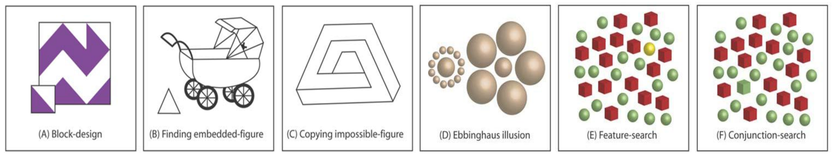
Background

Individuals with autism spectrum disorders (ASD) may show greater "local processing" e.g. reduced illusions like the Ebbinghaus and an enhanced ability to ignore context in perceptual tasks.

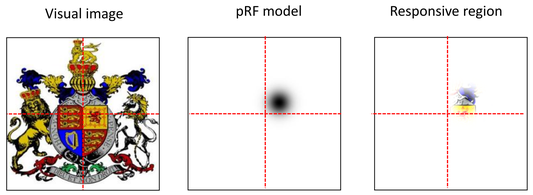


Dakin & Frith, 2005, *Neuron*

Is autism associated with atypical functional architecture in visual cortex?

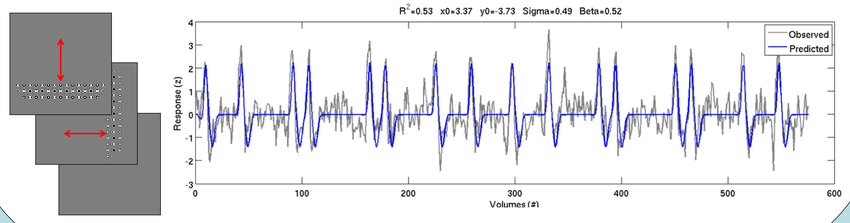
Methods

Population receptive field (pRF) analysis is a model-based approach to retinotopic mapping using fMRI. Instead of only estimating the visual field location each voxel responds to, it optimizes the parameters of the two-dimensional receptive field profile that best predicts the observed fMRI response to visual stimulation.



In its simplest form, the pRF model incorporates the Cartesian position of the pRF center (x,y), a measure of pRF size (σ), and a parameter for the response amplitude (β).

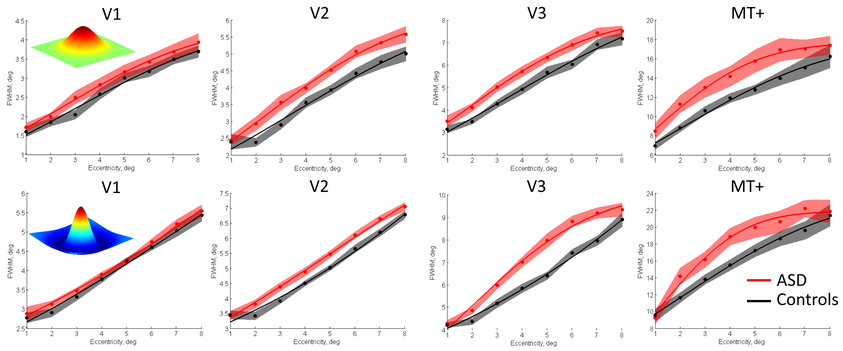
Inside the scanner, participants with ASD (n=14) and demographically matched neurotypical controls (n=12) viewed traversing, high-contrast bar stimuli while performing a simple fixation task. The overlap between the pRF profile and the stimulated part of the visual field at each time point was used to predict the neuronal pRF response. This prediction was further convolved with the hemodynamic response function (HRF) estimated through an independent scan. (Siemens 3T Trio, TR=2.55s, 30 slices, 2.3mm isotropic voxels).



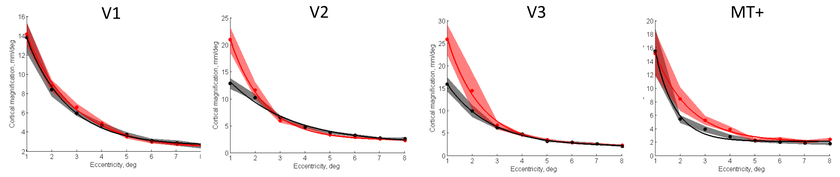
Methods loosely based on Dumoulin & Wandell, 2008, *NeuroImage*

pRF mapping results

We used the standard 2D Gaussian and a difference-of-Gaussians model that estimates inhibitory center-surround interactions (c.f. Zuiderbaan et al., 2012, *J. Vis.*).



Perifoveal pRFs in extrastriate areas were *larger* in individuals with ASD.

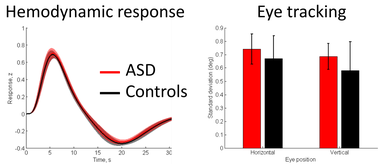


Central cortical magnification in V2 and V3 was also enhanced in ASD.

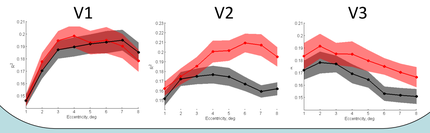
Circles: mean across participants. Shaded area: SEM. Solid lines: best fitting functions, using cumulative Gaussian (pRF FWHM) and exponential (cortical magnification), respectively.

Control analyses

These results were not due to differences in HRF shape and are unlikely to be explained by eye fixation stability.

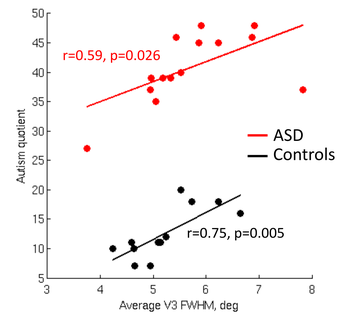


However, in ASD the signal-to-noise ratio was slightly higher, especially in V2.



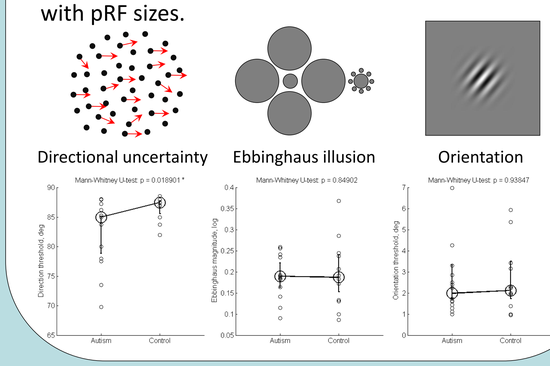
Correlation with AQ

Individual differences in pRF size correlated with severity of autistic symptoms (autism quotient, AQ).



Perceptual measures

In behavioral experiments outside the scanner we also measured (using a simple staircase procedure) perceptual thresholds for global motion perception, orientation discrimination, and the magnitude of the Ebbinghaus illusion. There were no differences between groups, except for global motion direction discrimination. None of these measures correlated with pRF sizes.



Conclusion and Discussion

Individuals with ASD showed larger pRFs in extrastriate cortex at perifoveal eccentricities.

Could this reflect flexible modulation of pRF size due to differential attentional deployment, i.e. a more local processing style in ASD?

- We have shown that larger perifoveal pRFs are associated with higher perceptual load at fixation (c.f. de Haas et al., abstract **#24.25**, *Sat. 3.30 pm*)
- Autism has been linked to abnormal perceptual load effects, in particular individuals with ASD may have enhanced "baseline" load (Ohta et al., 2012, *NeuroImage*)
- Autism has also been linked with a sharper gradient of spatial attention (Robertson et al., 2013, J Neurosci; c.f. also **#43.425**, *a few meters down the aisle…*)

Supported by wellcome trust