Evaluation of Enhanced Attention to Local Detail in Anorexia Nervosa using the Embedded Figures Test; an fMRI Study

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INTRODUCTION

- The behavioural literature in anorexia nervosa (AN) and autism spectrum disorders (ASD) has indicated an overlap in cognitive profiles with one such domain being the enhancement of local processing over global processing.
- While functional imaging of ASD using the embedded figures test (EFT) has revealed differential neural patterns compared to controls, no studies have explored such effects in AN.
- Studies of ASD using a low-level baseline have reported greater activation in occipital and parietal regions, but less activation in frontal regions.
- A recent study in AN found poorer visual memory and weaker central coherence on the Rey-Osterrieth Complex Figure Test , as well as decreased functional connectivity using resting-state fMRI in ventral occipital regions and the somatosensory cortex.

We hypothesize that people with AN will show superior performance, defined as faster reaction times and greater accuracy, alongside greater activation in occipital and parietal regions as compared to HC.

METHODS

Participants

- 35 female participants currently with AN (Mean age =23, BMI = 16) and 35 age-matched HC females screened for psychiatric illness (Mean age =25, BMI =22)

fMRI

- Images collected on a 1.5-T GE Signa HDx system with an 8-channel headcoil
- 225 whole-brain BOLD functional images were acquired using a T2*-weighted GE-EPI pulse sequence (TR =2000ms, TE =40ms, flip angle =70˚ , in-plane resolution 3.75x3.75mm, 25 axial slices of 5mm thickness parallel to AC-PC line)

fMRI analysis

- Data were pre-processed and analysed non-parametrically using XBAM v4.1 (http://brainmap.it; Fig. 1).

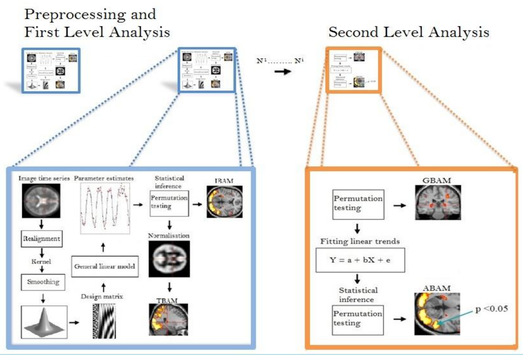

Fig 1: Pipeline of XBAM fMRI data analysis.

EMBEDDED FIGURES TEST

- Each trial of the EFT consisted of the simultaneous presentation of a target geometrical shape and two more complicated figures.
- Participants used a joystick (left or right) to indicate which of the two figures contained the target geometrical shape. The level of difficulty was manipulated by displaying figures that were either simple (SEF; Figure 2a) or complex (CEF; Figure 2b).

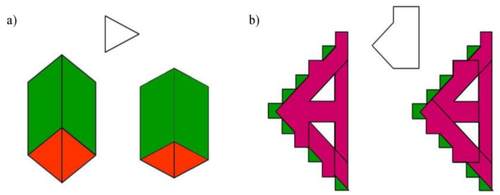

Fig 2: Schematic of the EFT. A total of 18 SEF and 18 CEF unique trials, each lasting for 10 seconds, were presented in alternating blocks of 3 trials.

- Both accuracy and reaction time were recorded for simple and complex trials.

RESULTS

Behavioural data

- There were no differences in reaction time between the groups, however HC made significantly less errors on both the simple and complex trials.

Imaging data

- The analyses revealed no group x task interaction.
- A main of effect of group was found when task conditions (SEF and CEF) were collapsed (Table 1, Fig 3), in which there was greater activation in the precuneus in HC and greater activation in the fusiform gyrus in AN.
- There was a trend towards greater activation in AN in the superior parietal lobule.

Table 1. Cluster properties showing a difference between groups on the EFT (SEF and CEF collapsed)

Region	Size	Mass	Talairach Coordinates			Direction	p
			X	Y	Z		
Precuneus	76	0.29	10.8	-44.4	36.9	HC > AN	.004
R Fusiform Gyrus	56	0.43	36.1	-56.3	-18.2	AN > HC	.003
L Superior Parietal Lobule	39	0.18	-25.3	-59.2	42.4	AN > HC	.009[a]

[a] This cluster did not survive correction for multiple comparisons

Acknowledgments

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Main Effect of Group

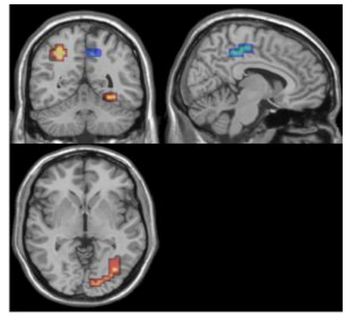

Fig 3: Coronal, sagittal and axial views showing greater activation in AN in the right fusiform gyrus and the superior parietal lobule (red) and for HC in the precuneus (blue) during the EFT.

CONCLUSIONS

- Unlike previous behavioural investigations, AN did not exhibit faster reaction times or greater accuracy on the EFT and the AN group actually made more errors than the HC group for both the simple and complex figures. .
- The HC group showed greater activation in the precuneus, a region known to be implicated in visuospatial imagery and more specifically, in shifting attention between targets. This suggests that HC are more engaged in the visual search component of the task.
- The AN group showed greater activation in the right fusiform gyrus, a region that has been associated with the recognition of objects through simultaneous spatial integration of features.
- Lateralization of this activation is in accordance with lateralized object recognition models, suggesting that the right hemisphere focuses more on conjoining features as opposed to isolating features.

We find that HC are better than AN at discriminating between two complex figures to discern which one contains a simple geometrical shape. This was demonstrated by the clear ceiling effect of 100% accuracy on the SEF trials and is in accordance with the notion of different cognitive strategies on the task as a whole (e.g. HC demonstrate greater visuo-spatial searching and AN employ a more object recognition-based approach).

LIMITATIONS

- The use of the EFT as a left/right forced choice paradigm as opposed to a yes/no identification task could have caused the difference between the results presented here and previous work
- In addition, shorter EFT trial durations (10 seconds as opposed to >60 seconds) in previous fMRI experiments have also led to finding no difference between groups