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Local and global visual processing and eating disorder traits: An event-related potential study

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ABSTRACT

Recent studies have suggested that individuals with eating disorders show a stronger local processing bias and/or a weaker global bias in visual processing than typical individuals. In this study, healthy participants with varying scores on the Eating Disorder Examination Questionnaire (EDE-Q) performed the Navon task, a standard task of local and global visual processing, whilst electrophysiological measures were recorded. Global stimuli were presented that were made up of many local parts, and the information between levels was either compatible or incompatible. Participants were instructed to report the identity of either a global or a local target shape, while ignoring the other level. Higher EDE-Q scores were associated with enhanced amplitude of the P3 component during local visual processing, as well as greater P1 amplitude during local incompatible trials. These findings support the claim that eating disorders are associated with differences in local and global visual processing.

1. Introduction

There is consistent evidence to suggest that individuals with eating disorders may have deficits in visuospatial processing (Lena, Fiocco, & Leyenaar, 2004; Zakzanis, Campbell, & Polsinelli, 2010). Eating disorders have been associated with poor performance on the Rey–Osterrieth Complex Figure (ROCF; Osterrieth, 1944), a test that involves copying a complex visual image and is assumed to rely on the ability to focus on global level information in the image. Compared with control participants, those with eating disorders tend to focus more on the local components of the figure than its global shape (Harrison, Tchanturia, & Treasure, 2011; Lopez et al., 2008a; Lopez, Tchanturia, Stahl & Treasure, 2008b; Lopez, Tchanturia, Stahl, & Treasure, 2009; Tenconi et al., 2010). Conversely, individuals with eating disorders have demonstrated superior performance on visual tasks requiring processing of local detail, such as the embedded figures test (Southgate, Tchanturia, & Treasure, 2008). Together, these findings suggest that individuals with eating disorders have a tendency to prioritise the processing of visual detail over global aspects of the visual input (Lask & Frampton, 2011; Lopez et al., 2008b). Indeed, a key aspect of eating disorders may be weak central coherence (Lopez et al., 2008b), which refers to a relative inability to successfully balance the processing of detail and context (Happé & Frith, 2006).

Until recently, research investigating local and global processing differences between individuals with and without eating disorders exclusively involved behavioural measures. A very recent study investigated the neural correlates associated with face identification in participants with Anorexia Nervosa (AN; Li et al., 2015). Using Event-Related Potentials (ERPs) they found smaller amplitudes in the P100 component in participants with AN compared to participants with Body Dysmorphic Disorder (BDD) and healthy controls, and smaller amplitudes in the face-related N170 component for both AN and BDD participants compared to healthy controls. As face identification depends on global level processing (Maurer, Le Grand, & Mondloch, 2002), these findings indirectly support the notion that eating disorders are associated with a bias towards processing local level information in vision.

Neuropsychological methods used to date have involved complex tasks such as the ROCF and the embedded figures test which take relatively long to complete, making them less suitable for use in neuroimaging. The main aim of the current study was to examine the neural correlates associated with the local processing bias in individuals with high and low eating disorder traits, by measuring ERPs associated with local and global visual processing in

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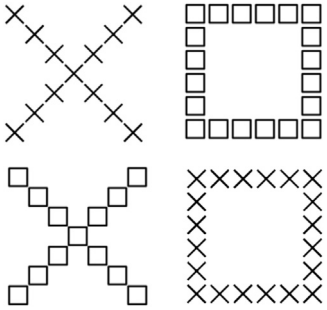

Fig. 1. The compatible (top) and incompatible (bottom) compound stimuli used in the study (Caparos et al., 2013). Images not to scale.

the Navon task. In the Navon task, participants are presented with hierarchical stimuli, consisting of many local elements that make up a larger global shape (Navon, 1977; see Fig. 1). The task is to identify a target stimulus at either the local or the global level, while ignoring the other level. There are two indices of local and global processing in the Navon task, namely the absolute speed of responding to local and global level targets, and the difference in latency between trials on which the information in the ignored level is compatible, versus incompatible with the current response. Typical participants tend to show a global processing bias by responding faster to global (versus local) targets, and having a smaller compatibility effect when responding to global (versus local) targets (Navon, 1977; Koivisto & Revonsuo, 2004; Pomerantz, 1983; see Kimchi, 1992, for a review).

Electrophysiological studies using the Navon task have identified certain ERP components associated with global and local processing in this task. Compared to global level processing, local level processing has generally been associated with greater amplitudes of the posterior P1 component and the N2 component (Han, Liu, Yund, & Woods, 2000; Han, Fan, Chen, & Zhuo, 1999; Han, He, Yund, & Woods, 2001) as well as longer N2 latencies and smaller amplitudes of the P3 component (Han, Fan, Chen, & Zhuo, 1997). However, Heinze, Hinrichs, Scholz, Burchert, and Mangun (1998) report that the P1 component is not always greater during local processing. The enhanced ERP amplitudes during local processing have been interpreted to reflect the greater demand on cognitive resources posed by the requirement to ignore the typically biased global level. Additionally, when the local and global level information was incompatible, the effect on the N2 and P3 amplitudes was greater during local processing than global processing (Han et al., 1997), suggesting that the global level interfered with local visual processing more than vice versa. Finally, there is some evidence that global information is processed more strongly in the right hemisphere and local information more strongly in the left hemisphere (Evans, Shedden, Hevenor, & Hahn 2000), although such lateralisation of activity is not always found (Jiang & Han, 2005).

In the current study, we compared the ERPs recorded during performance of the Navon task in healthy participants with either high or low scores on the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994; Fairburn, 2008). In terms of behaviour, we predicted that if eating disorder traits were associated with a reduced global processing bias, then the typical indices of a global bias (faster responses and reduced distractibility during global, compared to local processing) should be attenuated in the high (versus low) EDE-Q group. In terms of electrophysiology, we predicted that the ERP effects associated with local processing in typical participants (larger P1 and N2 amplitude, longer N2 latency, smaller P3 amplitude, left lateralisation of activity) will be modulated in participants who report high levels of eating disorder symptoms. As the available evidence of differences in global and local processing between people with and without eating disorders is largely limited to behavioural measures, this study aims to provide a greater understanding of neural correlates underlying such differences.

2. Method

2.1. Participants

Thirty-four healthy female participants aged between 18 and 57 ($M = 28.10$, $SD = 10.24$) participated in the experiment. Data from four participants with a high number of artefacts in the ERPs were excluded from further analysis. All participants had normal or corrected-to-normal vision. An advertisement was created for the study that detailed the study procedure (including the EEG procedure and questionnaires), the aim of the study was not mentioned. This advertisement was shared via social media. The majority of participants were postgraduate students recruited from the Psychology Department at Goldsmiths, University of London. The remaining participants were known to the experimenters and approached in person or via email. None of the participants received compensation for participating in the study. Participants with a diagnosed eating disorder were excluded from the study. All gave informed consent and the study was approved by the Ethics Committee at the Department of Psychology, Goldsmiths, University of London.

2.2. Measures

2.2.1. Eating Disorder Examination Questionnaires (EDE-Q)

The Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994; Fairburn, 2008) was used to assess the level of eating disorder symptomatology over the past 28 days. It consists of 28 items that are rated by the participant on a 7-point scale (from 0 to 6), where a higher score indicates greater pathology. Five further items assess the current weight and height of the participant, and whether they have missed any menstrual periods. The EDE-Q has been found to be both reliable and valid (Luce & Crowther, 1999; Peterson et al., 2007) as well as valid for screening for eating disorders in a community sample (Mond, Hay, Rodgers, Owen, & Beumont, 2004). Mond et al. (2004) found that the mean global score for eating disorder cases was 3.09 ($SD = 0.83$) compared to a mean global score for non-cases of 1.30 ($SD = 0.96$). For the purpose of this study a median split was used to separate the participants into two groups. Those that fell into the lower 50% were included in the Low EDE-Q group and those that fell into the higher 50% were included in the high EDE-Q group. This method has been used on both clinical samples (Striegel et al., 2010; Rawal, Williams, & Park, 2011) and non-clinical samples (Duckham et al., 2012; Martijn, Vanderlinden, Roefs, Huijding, & Jansen, 2010). Martijn et al. (2010) used a median split on EDE-Q subscales to create 'High' and 'Low' body concern groups on the EDE-Q and found a median of 1.70. This is similar to the median found in this study of 1.78.

Previous research has found that mood and anxiety (as well as eating disorder symptoms) are associated with a local processing style (Derryberry & Reed, 1998; Fredrickson, 2004; Zadra & Clore, 2011). Therefore to fully understand the characteristics of the current sample additional psychometric measures were used in this study (see below). Additionally as a large proportion of the participants recruited for the study were postgraduate students, an assessment of intelligence was used to investigate if the two groups significantly differed on IQ. See below for full details.