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Blunted neural response to implicit negative facial affect in anorexia nervosa

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ABSTRACT

Background: People with anorexia nervosa (AN) have difficulties in a wide range of social-emotional processes. Previous work suggests atypical involvement of the prefrontal cortex (PFC), amygdala, insula, and fusiform gyri during social-emotional processing in AN.
Methods: Twenty women with AN and twenty healthy comparison (HC) women were presented with happy, fearful, and neutral faces during a functional magnetic resonance imaging study. Group differences were investigated in the following regions of interest: lateral PFC, amygdala, insula, and fusiform gyri.
Results: The HC participants showed significantly increased recruitment of the ventrolateral PFC and amygdala in the fearful > neutral contrast relative to the AN participants. The AN participants showed a significantly increased recruitment of a small cluster in the right posterior insula in the happy > neutral contrast.
Conclusions: These findings are in line with the hypothesis that people with AN have a blunted response to negative and atypical exaggerated response to positive emotionally provoking stimuli.

1. Introduction

Difficulties in social-emotional processing are believed to play an important role both in the onset and maintenance of anorexia nervosa (AN) (Treasure, Corfield, & Cardi, 2012; Treasure & Schmidt, 2013). A wide range of anomalies in social-emotional processing and reactivity to emotional stimuli have been documented in people with acute AN (Bora & Köse, 2016; Caglar-Nazali et al., 2014; Davies et al., 2016). Furthermore, longitudinal cohort studies have reported that difficulties in social cognition and social communication at admission are important predictors of poor treatment outcome at 3- to 18-year follow-up (Nielsen et al., 2015; Speranza, Loas, Wallier, & Corcos, 2007). Thus, these difficulties may contribute to the maintenance of the illness and further understanding of these processes is of importance.

Behavioural studies have documented difficulties in a range of different aspects of social-emotional processing in acute AN (Bora & Köse, 2016; Caglar-Nazali et al., 2014; Davies et al., 2016). Some experimental studies have suggested difficulties in explicit processing of social-emotional cues, such as recognition of facial expressions, in AN (Caglar-Nazali et al., 2014; Oldershaw et al., 2011). However, more recent studies have suggested that these difficulties may be driven by anomalies in interpretation and reactivity to social-emotional cues in AN (Ambwani et al., 2015; Dapelo, Surguladze, Morris, & Tchanturia, 2016). Indeed, people with AN perceive emotionally provoking stimuli to be more negative and colder than healthy comparison (HC) participants (Ambwani et al., 2015; Cardi et al., 2014). Additionally, relative to HCs, people with AN display reduced facial affect in response to emotionally provoking stimuli (Davies et al., 2016). Taken together, these findings suggest that there may be specific anomalies in implicit processing and reactivity to social-emotional cues in AN and further exploration of the neural mechanisms that underlie these processes may be of interest.

Few studies have examined the neural processes that underlie difficulties in social-emotional processing and reactivity to emotional stimuli in people with AN. A recent review reported reduced response in prefrontal regions, including the lateral and medial prefrontal cortex (PFC), while viewing social behaviour in acute AN (McAdams & Smith, 2015). Further, one of the included studies found that reduced response in the lateral and medial PFC to social behaviour at admission to treatment was associated with poorer outcome at discharge (Schulte-Rüther, Mainz, Fink, Herpertz-Dahlmann, & Konrad, 2012). A recent study investigating implicit processing of happy faces of increasing intensity found greater linear increase in activation of the fusiform gyrus in people with acute AN relative to HCs (Fonville, Giampietro,

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Surguladze, Williams, & Tchanturia, 2014). Another study, using a more explicit task, found reduced amygdala response in people recovered from AN relative to HCs in response to negative facial expressions when the faces were coupled with the congruent emotion label (Bang, Ro, & Endestad, 2016). Despite the relative paucity of research in this field, these findings suggest possible anomalies in the recruitment of frontal, amygdala, and visual attentional regions in social-emotional processing in AN.

More work has been conducted in anxiety and mood disorders, which are common comorbid disorders in AN and share similar difficulties in social-emotional processing and reactivity to emotional stimuli (Davies et al., 2016; Hambrook, Brown, & Tchanturia, 2012; Treasure, Stein, & Maguire, 2015). A recent meta-analysis found that relative to HCs, people with depression showed hyperactivation of regions associated with appraisal including amygdala, insula, and fusiform gyrus, during implicit processing of negative facial affect (Groenewold, Opmeer, de Jonge, Aleman, & Costafreda, 2013). Additionally, increased activation of these regions was associated with reduced recruitment of regions associated with emotion down-regulation, including the lateral PFC (Groenewold et al., 2013). Similarly, people with generalised and social anxiety disorders show reduced activation of lateral PFC and associated hyperactivation of the amygdala when processing negative emotional stimuli including negative facial expressions (Mochcovitch, da Rocha Freire, Garcia, & Nardi, 2014). Taken together, these findings suggest that there may be a deficit in prefrontal down-regulation and limbic up-regulation of negative emotion associated with depression and anxiety.

The aim of the current study was to examine the neural substrates employed during implicit processing of positively and negatively valenced facial expressions in AN and HC participants. Based on the neuroimaging findings outlined above, we hypothesised that participants with AN would have atypical pattern of reduced recruitment of lateral PFC while processing emotional faces. Further, based on previous work conducted in mood and anxiety disorders as well as behavioural work in AN, we hypothesise that participants with AN would show a pattern of activation suggestive of anomalies in emotional reactivity. Specifically, we hypothesise that relative to the HCs, participants with AN would show increased activation in the amygdala, insula, and fusiform gyri while processing the emotional facial expressions.

2. Materials and methods

2.1. Participants

Forty right-handed females participated in the study. Twenty participants had a current DSM-IV diagnosis of AN, which was confirmed using the Structured Clinical Interview for Diagnosis – Researcher Version (Spitzer, Williams, Gibbon, & First, 1992). Fifteen participants with AN were recruited from the community through advertisements posted on eating disorder charity websites (i.e. BEAT and Succeed). The AN participants recruited from the community were not receiving psychological treatment during the time of the study. Five participants with AN were recruited from the Bethlem Royal Hospital, South London and Maudsley NHS Trust and were receiving treatment during the study. 60% of the participants with AN were taking antidepressants during the time of the study, 45% of the AN participants reported comorbid depression and 25% reported comorbid anxiety disorder. Twenty age-matched HC women of healthy weight were recruited from the community and amongst King's College London students and staff.

The exclusion criteria for all participants were a history of head trauma, hearing or visual impairment, neurological disease, MRI incompatibility, acute suicidality, and history of (or current) alcohol or drug abuse. Additionally, HC participants were screened with the Structured Clinical Interview for Diagnosis − Researcher Version (Spitzer et al., 1992) and were excluded if they had current or a history of psychiatric disorders. HC participants were also excluded if did not have BMI between 18.5 and 25.0 or were taking psychotropic medication. All participants gave a written, informed consent prior to taking part in the study and were compensated for their participation. The study was approved by a National Research Ethics Service committee (approval number: 11/LO/0373) and was conducted in accordance with the latest version of Declaration of Helsinki.

2.2. Questionnaire measures

The eating disorders examination questionnaire (EDEQ) (Fairburn & Beglin, 1994), a 36-item self-report measure, was used to assess eating restraint, eating concern, shape concern, and weight concern over the past 28 days.

The depression, anxiety, and stress scale (DASS) (Lovibond & Lovibond, 1995), a 21-item self-report measure, was used to assess depression, anxiety, and stress over the past two weeks.

2.3. Design and procedure

During a 6-min event-related functional magnetic resonance imaging (fMRI) task participants were presented with black and white images of faces (Fig. 1). The face stimuli consisted of prototypical happy (intensity: 100%), prototypical fearful (intensity: 100%), and neutral faces. The stimuli were selected from a standardised set of facial expressions (Ekman & Friesen, 1976), and consisted of ten different adults displaying each of the selected emotions (5 female and 5 male). Happy and fearful faces were used as they have previously been found to strongly capture participants' attention and produce robust activation of the amygdala, fusiform gyrus, insula, and prefrontal regions (Fusar-Poli et al., 2009;

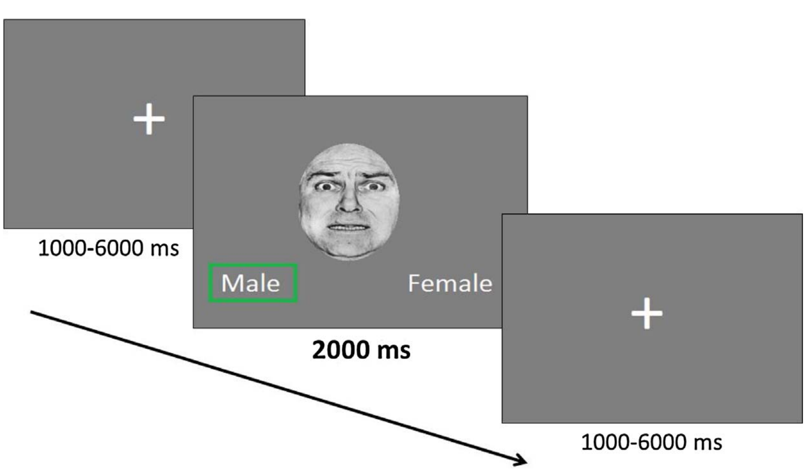

Fig. 1. Implicit emotion processing task.
The happy, fearful, and neutral faces were presented one at a time for 2000 milliseconds (ms) during which participants identified the gender of each face. Faces were preceded by a fixation cross the presentation of which was jittered between 1000 and 6000 ms.