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Altered emotional information processing in borderline personality disorder: An electrophysiological study

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ABSTRACT

Emotional dysregulation is one of the key symptoms of patients with borderline personality disorder (BPD). In the present study it is hypothesized that borderline patients display a cortical hyper-responsivity to emotional stimuli compared with a healthy control group. Further, we aimed to examine whether BPD patients were able to suppress stimuli with negative emotional valence as well as healthy control participants could. This is the first study addressing the electrophysiological processing of emotional stimuli in BPD. The electrophysiological response to emotional information was studied among 30 BPD patients and compared with the response in 30 normal controls using event-related potentials (ERPs). Participants were shown pictures selected from the International Affective Picture System with neutral, positive, and negative valence. After performing an attentional task, the participants were asked to perform a reappraisal task. The assignment was to consciously suppress emotions that might occur after viewing pictures with an unpleasant content. Borderline patients displayed larger late positive potentials (LPP) to pictures with an unpleasant valence as compared with the control group, indicating an enhanced elaborative processing of unpleasant stimuli. However, they did not differ on the reappraisal task. Borderline patients show an enhanced emotional cortical reactivity to unpleasant stimuli as compared with a control group. This suggests an emotional dysfunctioning in BPD patients. This feature might be an important focus in the treatment of BPD.

1. Introduction

Borderline personality disorder (BPD) is a psychiatric disorder that can be defined as "A pervasive pattern of instability of interpersonal relationships, self-image, and affects, and marked impulsivity beginning by early adulthood and present in a variety of contexts" (American Psychiatric Association, 1994).

Affective instability is a core diagnostic criterion of BPD, resulting in inappropriate anger, chronic feelings of emptiness and great rapidity of mood swings (Lieb et al., 2004). Previous studies show that BPD patients report higher affective lability and higher affect-intensity than do patients with other personality disorders (Henry et al., 2001). Some theories (e.g., Linehan, 1993) stress the 'hypersensitivity' of BPD patients to emotional stimuli.

Most of the knowledge concerning emotional instability in BPD is derived from self-report questionnaires. For example, Levine et al. (1997) found that BPD patients differed from normal controls in their capacities in processing emotions. That is, BPD patients displayed more difficulties in recognizing, differentiating and integrating emotions, and responded more intensely to negative emotional stimuli as compared with controls (Levine et al., 1997). In addition, BPD patients were found to report longer duration and higher intensity of subjectively perceived states of aversive tension compared with a control group (Stiglmayr et al., 2001). However, these self-report measurements are hampered by their highly subjective nature, and there is hardly any consensus about which self-report measures should be used (Blount et al., 2002).

For this reason, more recent studies have examined emotional instability employing a physiological approach. For example, Herpertz et al. (1999) used measures of heart rate, skin conductance and startle response in addition to self-reports as a reaction to standardised slides with neutral or negative emotional valence. In contrast to the hypothesis of affective hyperarousal, it was found that BPD patients did not respond with more intense emotional reactions than did normal controls. In fact, although BPD patients reported higher arousal ratings on the questionnaires, they responded with a decreased level of electrodermal responsiveness to affective stimuli. A possible explanation for this remarkable finding is that BPD patients might 'overcompensate' for this under-arousal by engaging in impulsive and thrill-seeking behavior (Herpertz et al., 1997). Alternatively, it might indicate that BPD patients "over-interpret" their physiological signals.

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Recent functional magnetic resonance imaging (fMRI)-studies suggest that the amygdala, which has a central role in emotional regulation, differs from healthy controls. In female patients with BPD, reductions of the volumes of the hippocampus and amygdala were found compared with a control group (Driessen et al., 2000; Tebartz van Elst et al., 2003), suggesting abnormalities in brain areas associated with emotional processing. In addition, exposure to emotional stimuli can lead to enhanced amygdala activation levels in borderline patients as compared with normal controls (Herpertz et al., 2001; Donegan et al., 2003), suggesting an affective dysregulation. Other neurophysiological studies show dysfunctions in interconnecting systems of the brain that are responsible for emotional processing (Johnson et al., 2003; Lis et al., 2007).

Electrophysiological research using electroencephalograms (EEG) is a relatively inexpensive and non-invasive method to examine mental processes with better temporal resolution compared with fMRI measures. In a review addressing electrophysiological aberrations in BPD, it was found that EEG research in the disorder is scarce and that many studies are hampered by methodological limitations (Boutros et al., 2003). EEG studies have examined sleep patterns (Benson et al., 1990; Battaglia et al., 1993; De la Fuente et al., 2001; Asaad et al., 2002), error processing (Ruchsow et al., 2006) and self-injurious behavior (Russ et al., 1999) in BPD patients. In a recent study of Meares et al. (2005), it was found that BPD patients show distinctive disturbances in P3a event-related potentials (ERPs) to auditory stimuli, suggesting a general failure of frontal maturation and a lack of coordination among frontal and more posterior frontal networks. Also, Houston et al. (2005) performed a study among adolescent girls, in which girls with borderline features failed to show normal age-related reductions in p300 amplitude compared with girls without BPD-related features. It is suggested that adolescent girls who exhibit BPD features show abnormal brain maturation (Houston et al., 2005). To the best of our knowledge, no EEG study has examined the role of emotional information processing in BPD before.

The late positive potential (LPP), which is a P3-like wave capturing the later elaborative stage of stimulus processing, is a frequently employed electrophysiological index of emotional processing (Olofson et al., unpublished results). This index of processing emerges 300–400 ms after stimulus onset and can stay present for several seconds (Cuthbert et al., 2000). Studies addressing the neural origin of this enhanced positive slow wave show that it represents activity in a network of visual cortical structures such as the lateral occipital, inferotemporal, and parietal visual areas (Sabatinelli et al., 2007).

The present study addresses whether BPD patients, as compared with normal controls, have an altered electrophysiological response to emotional information. In concordance with the theory of Linehan (1993), we hypothesized that BPD patients are hypersensitive to both negative and positive emotional stimuli as compared with a control group. More specifically, we expected that the LPP to emotional stimuli (Ito et al., 1998; Schupp et al., 2000) would be enhanced in BPD patients compared with healthy controls, suggesting an enhanced processing of these cues.

An additional aspect of emotional regulation is the control over the emotional response. It is known that cognitive strategies such as reappraisal reduce the intensity of negative experiences in normal subjects (Hajcak and Nieuwenhuis, 2006; Moser et al., 2006). In a recent study of Domes et al. (2006), it was found that BPD patients showed reduced inhibition of negative emotional material compared with normal controls on a cognitive 'directed forgetting' task, although no differences between the groups were found during an emotional Stroop task. Other studies demonstrated that BPD patients perform worse than control groups in suppressing negative emotional stimuli during an emotional Stroop task (Arntz et al., 2000; Sieswerda et al., 2007). In a recent review addressing the neurobiology of BPD, it has been suggested that there is a missing link between brain areas that regulate and control emotions and their outcome. The poor emotion regulation often seen in BPD is thought to be the result of a failure of rational thought to control emotional thought (Lis et al., 2007). Studies addressing emotion regulation in BPD patients show inconsistent results, although the issue of whether these patients have an altered ability to consciously control their emotions is both theoretically and clinically very relevant.

Therefore, the second aim of this study is to examine whether BPD patients differ from normal controls in ERP reactivity when performing a cognitive reappraisal task during exposure to negative emotional stimuli. More specifically, we expected that the LPP, an index of emotional processing, would be less reduced under conditions of suppression of negative emotion in BPD patients as compared with healthy controls (Moser et al., 2006), suggesting that BPD patients have a reduced inhibitory control over negative emotions.

2. Method

2.1. Participants

Participants were 60 females between the age of 18 and 40 years. The control group ($n=30$) consisted of healthy females recruited through advertising. Exclusion criteria for the control group were current psychiatric diagnosis and the use of benzodiazepines. The patient group consisted of BPD patients who were in outpatient treatment at the Centre for Personality Disorders (CPP) in The Hague, The Netherlands. All patients included were diagnosed as BPD patients (according to DSM-IV criteria) by experienced clinicians (psychiatrist and psychologist) of the treatment centre. To minimize influences of co-morbid disorders, the following exclusion criteria were used: major depression, any anxiety disorder, attention deficit hyperactivity disorder, alcohol or drug dependence or abuse, current psychotic symptoms, or post-traumatic stress disorder.

Medication use among the BPD patients was as follows: antidepressants, 43%; antipsychotics, 7%; and antidepressants plus antipsychotics, 20%. All patients were stable in their medication intake over the last 3 months. Participants using benzodiazepines were excluded since benzodiazepines are known to influence emotional processing and EEG measurement (Johannes et al., 2001; de Bruijn et al., 2004).

The BPD patients ($n=30$) were recruited from an outpatient treatment Centre for Personality Disorders in The Hague, Netherlands. All patients who met the inclusion criteria were approached by their therapist and were provided with information explaining the study. They were handed the written patient information and were given as much time as needed to decide whether or not they were willing to participate in the study. Written informed consent was obtained from all participants. All participants received 25 Euro for their participation in the study. Approval for the study was provided by the local Medical Ethical Commission according to the principles of the Declaration of Helsinki as adopted in Hong Kong (1989).

The mean age in the control group ($M=25.1$) was lower than in the patient group ($M=29.9$; $P<0.01$). Both groups had comparable levels of education (percentages of higher education in the patient and control group were 48% and 27%, respectively (Fisher's exact test; $P>0.1$)). All participants were right handed and signed informed consent before participation in the study.

In addition to the clinical diagnosis determined by a psychiatrist and psychologist, the BPD section of the Structured Clinical Interview for DSM-IV personality disorders (SCID-II; Spitzer et al., 1992; Weertman et al., 2003) was administered by a trained research assistant to all participants. All borderline diagnoses of the patients were confirmed by the SCID. Further, none of the controls had a BPD according to the SCID. Further, both groups were compared on baseline characteristics. As can be observed in Table 1, patients had significantly higher scores on indices of borderline symptoms on the