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Dissociation in borderline personality disorder: Disturbed cognitive and emotional inhibition and its neural correlates

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ABSTRACT

Evidence is heterogeneous regarding whether patients with borderline personality disorder (BPD) display disturbed emotional inhibition in the emotional Stroop task. Previous findings suggest that state dissociation may influence cognitive inhibition of task-irrelevant material, particularly with negative content. Our aim was to examine performance in an emotional Stroop task including negative, neutral, and positive words in BPD patients and healthy controls during functional magnetic resonance imaging. In advance, half of the BPD patients underwent a dissociation induction using script-driven imagery. BPD patients without dissociation induction showed behavioural performance comparable to that of healthy controls but displayed stronger neural responses, especially to positive stimuli, in the superior temporal gyrus, dorsomedial prefrontal cortex, and anterior cingulate cortex. BPD patients with dissociation induction showed overall slower and less accurate responses as well as increased reaction times for negative versus neutral words compared with BPD patients without dissociation induction. Moreover, they showed comparatively decreased neuronal activity in the fusiform gyrus and parietal cortices independent of valence, but elevated activity in the left inferior frontal gyrus in response to negative versus neutral words. In conclusion, experimentally induced dissociation in BPD was associated with inefficient cognitive inhibition, particularly of negative stimuli, in the emotional Stroop task.

1. Introduction

Emotion dysregulation is considered to be a core feature of borderline personality disorder (BPD; Koenigsberg et al., 2002; Zittel Conklin et al., 2006; Glenn and Klonsky, 2009). BPD patients have been found to show intensive and prolonged reactions to aversive stimuli (Herpertz et al., 1997; Wagner and Linehan, 1999; Stiglmayr et al., 2005). Hence, emotional information may capture more attention in BPD patients than in healthy controls, even when this emotional information is irrelevant to the target task (for a review, see Winter et al., 2014). The paradigm most often employed to study this hypothesis of impaired *emotional inhibition* is the emotional Stroop task (EST; Mathews and MacLeod, 1985). In the EST, participants are required to name the colour of emotional or neutral words. The longer a participant takes to name the colour of a word, the more the stimulus' content is thought to capture the participant's attention. Results however are heterogeneous: some studies show that BPD patients have longer reaction times compared to healthy individuals when naming emotional vs. neutral stimuli, especially for negative words (Arntz et al., 2000; Sieswerda et al., 2007; Wingenfeld et al., 2009a), but also for positive words (Sieswerda et al., 2007). In juxtaposition, other studies have not found significant differences between BPD patients and healthy controls for this paradigm (Sprock et al., 2000; Domes et al., 2006; Minzenberg et al., 2008; Wingenfeld et al., 2009b).

In addition, inconsistent findings were reported when using functional magnetic resonance imaging (fMRI) to study emotional inhibition. Stronger interference of word content during colour naming in the EST is usually associated with increased activity in the anterior cingulate cortex (ACC) and frontal areas including the inferior frontal gyrus (IFG)-areas (among others) active in tasks

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requiring to divert attention-as well as in areas involved in semantic processing such as the lateral inferior parietal cortex and the superior temporal gyrus (Whalen et al., 1998; Britton et al., 2009; Hart et al., 2010; Mincic, 2010; Ovaysikia et al., 2011). In BPD, one study found that patients lacked differential activation in relevant brain regions including the ACC and prefrontal cortex in response to negative compared to neutral stimuli, suggesting a smaller difference between emotional and neutral stimuli in the EST (Wingenfeld et al., 2009b). Using a modified EST, another study found decreased medial orbitofrontal and subgenual ACC activation as well as increased activity in the insula, dorsal ACC, and lateral orbitofrontal areas in BPD patients in comparison with healthy controls, pointing to increased recruitment of areas associated with diverting attention (Silbersweig et al., 2007).

The factors that underlie these inconsistent reports have yet to be established. Some authors suggest that methodological limitations and modifications the original EST study design may explain these inconsistencies (Domes et al., 2006; Minzenberg et al., 2008; Wingenfeld et al., 2009a,b). Personal stimulus relevance, anxiety, childhood trauma, Axis I comorbidity and overall prolonged reactions times in BPD may have masked a possible effect of emotional word content (Domes et al., 2006; Sieswerda et al., 2007; Wingenfeld et al., 2009a).

So far, no studies have tested whether the current presence of dissociation, hereafter referred to as “state dissociation”, may contribute to inconsistencies in EST performance. Dissociation is defined as a “disruption of and/or discontinuity in the normal integration of consciousness, memory, identity, emotion, perception, body representation, motor control, and behaviour” (American Psychiatric Association, 2013; p. 291). State dissociation is transiently experienced by two thirds of all BPD patients and has manifold manifestations, including derealisation, depersonalisation, and amnesia (Zanarini et al., 2000, 2008; Korzekwa et al., 2009). Two streams of research suggest that dissociation may influence BPD patients’ EST performance. One suggests that inefficient inhibition of task-irrelevant information regardless of valence (further referred to as *cognitive inhibition*) may be a characteristic of BPD patients who exhibit high levels of state dissociation. Only one study to date has investigated the association of this cognitive function and dissociation in BPD, though it observed dissociation solely as a trait but not as a state (Haaland and Landro, 2009). This study found that BPD patients with high levels of trait dissociation performed worse than healthy controls in all tested domains, including executive functioning and, more specifically, performance on a non-emotional Stroop task. This suggests also impairments in cognitive inhibition in BPD patients with high levels of trait dissociation. In this regard, it is interesting to note that BPD patients had overall longer reaction times than healthy controls in most studies using the EST-even in response to non-emotional words (Arntz et al., 2000, Domes et al., 2006, but not Wingenfeld et al., 2009a,b). No study so far has investigated whether this result is associated with high state dissociation in BPD.

The second stream of research suggests that dissociation can have an impact on the processing of affect-laden materials. BPD patients with high levels of state dissociation lacked differential reactions to an conditioned stimulus paired with an aversive event (CS+) compared to a neutral stimulus (CS−) in an aversive conditioning paradigm (Ebner-Priemer et al., 2009). Also, state dissociation in BPD was associated with decreased startle responses but increased skin conductance in response to aversive pictures (Barnow et al., 2012). Furthermore, an fMRI study found that state dissociation correlated negatively with activity in the amygdala, hippocampus, ACC and insula during distraction from negative pictures in an emotional working memory task in BPD patients (Krause-Utz et al., 2012). Thus, a valence-specific effect of negative materials on cognitive inhibition may be found in BPD patients with high state dissociation. However, to our knowledge, no studies have experimentally manipulated the levels of state dissociation and its effect on task-irrelevant emotional information in BPD yet.

In sum, there is a lack of evidence regarding the association of high state dissociation and (1) inefficient cognitive inhibition over task-irrelevant information and (2) a smaller difference between the inhibition of emotional content compared with neutral content in the EST in BPD. To examine these research gaps, we used personalised script-driven imagery-which has been shown to be capable of inducing high state dissociation (Lanius et al., 2002; Ludascher et al., 2010)-combined with the EST and related memory tasks (recall and recognition). We hypothesised that dissociation induction in BPD would be associated with (1) inefficient cognitive inhibition over task-irrelevant information as reflected in overall slower reaction times and more errors in the EST and the succeeding memory tasks, as well as altered task-related neural activity e.g. in the ACC, the inferior parietal cortex, the superior temporal gyrus, and the IFG in the EST (Whalen et al., 1998; Britton et al., 2009; Hart et al., 2010; Mincic, 2010; Ovaysikia et al., 2011), and that (2) dissociation induction in BPD would be associated with smaller difference in the inhibition of negative stimuli (compared to neutral stimuli) in the EST, i.e. a smaller difference between reaction time latencies and response accuracy for negative versus neutral words, and smaller differential neuronal task-related activity in these brain regions when comparing negative to neutral words.

2. Methods

2.1. Sample

The participants comprised 40 women with BPD and 20 healthy controls (HC) between 18 and 45 years of age. Due to movement artefacts during fMRI scanning, four subjects were excluded from the analysis. The final sample included 19 HC, 19 BPD patients who did not undergo dissociation induction (BPDn), and 18 BPD patients who underwent dissociation induction (BPDd). General exclusion criteria were serious somatic illnesses, traumatic brain injuries, current and lifetime psychotic or bipolar-I disorder, psychotropic medication (within 4 weeks prior to the study), developmental disorders, substance dependency during the last year, and substance abuse within two months prior to the study. For MRI, exclusion criteria were metal implants, pregnancy, left-handedness, and claustrophobia. BPD patients had to fulfil the DSM-IV criteria for BPD, including the criterion for stress-related dissociation. Further exclusion criteria for HC were any current or previous mental disorder. BPD patients were randomly assigned to either the BPDn or BPDd group.

Clinical diagnoses were assessed by trained diagnosticians using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; Wittchen et al., 1997) and the BPD section of the International Personality Disorder Examination (IPDE; Loranger, 1999). Self-report measures included questionnaires on BPD symptom severity [Borderline Symptom List short version (BSL-23; Bohus et al., 2009)], childhood trauma [Childhood Trauma Questionnaire (CTQ; Bernstein et al., 2003)], trait dissociation [Dissociative Experience Scale (DES; Bernstein and Putnam, 1986)], severity of depressive mood [Beck Depression Inventory (BDI; Beck et al., 1961)], as well as trait and state anxiety [State Trait Anxiety Inventory (STAI; Spielberger et al., 1970)]. Questionnaire data were collected in a 3 day period before or after the experiment. State dissociation and tension were measured using the fMRI-suited Dissociation-Stress-Scale-4 (DSS-4; Stiglmayr et al., 2009). The five