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REJECTION PROMPTS APPROACH MOTIVATION AND HOSTILITY AMONG INDIVIDUALS WITH BORDERLINE PERSONALITY DISORDER

A Dissertation in

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By

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ABSTRACT

Research suggests individuals with borderline personality disorder (BPD) are acutely sensitive to social rejection. Furthermore, unlike other disorders marked by greater sensitivity to rejection such as major depression (MDD), those with BPD appear to experience increased hostility in response to rejection, which often precedes a myriad of maladaptive behaviors. However, potential mechanisms between rejection experiences and hostility with individuals with BPD have not been elaborated. The goal of the present study was to assess whether rejection prompts relatively greater left frontal cortical activation among BPD patients, consistent with approach motivation, and whether BPD patients were more hostile following rejection. We assessed EEG asymmetry at baseline, after a rejection task, and after a subsequent retaliation task. Compared to healthy controls and MDD patients, BPD patients evidenced greater left frontal asymmetry after being rejected and provided more hostile responses on one metric, but not another, in the subsequent task. The implications of these findings are discussed along with a discussion of lower overall frontal alpha values among the BPD group. Factors in promoting maladaptive behavior following rejection among individuals with BPD appears to be rejection sensitivity and approach motivation.

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Chapter 1

Introduction

Research has drawn parallels between social and physical pain, clearly illustrating the fundamental human need to belong and affective and visceral responses when this need is threatened by rejection (e.g., Baumeister & Leary, 1995). Although sensitivity to rejection is an adaptive mechanism that motivates social engagement, extreme sensitivity is thought to underlie vulnerability for major psychiatric and personality disorders. Some feel the sting more acutely and react destructively in response to rejection (e.g., Downey & Feldmen, 1996). People with high sensitivity to rejection often become angry, desperate and aggressive following ostracism, ironically enacting behaviors that increase their likelihood of being rejected. At the extreme end of rejection sensitivity, a phenotype often displayed by individuals with borderline personality disorder (BPD), people may respond to difficult interpersonal interactions with self-destructive behaviors, self-harm, suicidality, hostility or desperate clinging or stalking (Critchfield, Levy, Clarkin, & Kernberg, 2008; Berenson, Downey, Rafaeli, Coifman, & Paquin, 2011; Brodsky, Groves, Oquendo, Mann, & Stanley, 2006; Brown, Comtois, & Linehan, 2002; Lawrence, Chanen, & Allen, 2011; Kelly, Soloff, Lynch, Haas, & Mann, 2000; Stepp, Pilkonis, Yaggi, Morse, & Feske, 2009; Limberg, Barnow, Freyberger, & Hamm, 2011). At this extreme, BPD patients present a highly conflicted and painful mix of desperate needs for connection and painfully raw susceptibility to interpersonal rejection.

While rejection sensitivity is a core trait of BPD, it is certainly not the only disorder characterized by heightened interpersonal sensitivity. Individuals prone to major depressive disorder (MDD) evince elevated rejection sensitivity as well (Slavich et al., 2009; Nezlek et al., 1997). In addition to this sensitivity, the two disorders broadly overlap in a number of features. Symptoms of dysphoric affect, suicidality, irritability and heightened anxiety are common among the two disorders, often leading to diagnostic confusion. In fact, in the absence of structured interviews or training to detect personality disorders, BPD and MDD are often confused (Hillman, Stricker, & Zweig, 1997; Meyerson, 2009). The two disorders have a high rate of comorbidity (Widiger & Trull, 1993), suggesting they potentially share a common mechanism, though ample research also supports differentiation between the two disorders (Widiger & Trull, 1993; Gunderson & Phillips, 1991). However, though rejection sensitivity and other symptoms are overrepresented in both populations (Ayduk, Downey, & Kim, 2001; Staebler, Helbing, Rosenbach, & Renneberg, 2011), reactions to rejection among these two groups are distinct. While individuals with MDD tend to respond to interpersonal stressors by withdrawing and isolating (Slavich, Thornton, Torres, Monroe, & Gotlib, 2009), individuals with BPD seem to do just the opposite, to approach, to become angry, and to desperately act to avoid rejection. In response to social rejection, individuals with BPD experience onerous affective states, such as deep distress, aversive and tense arousal and anger that is disproportionate to the severity of the situation (Stiglmayr et al., 2005), emotions that are often accompanied or followed by problematic behaviors such as aggression (Berenson et al., 2011), substance abuse (Kruedelbach, McCormick, Schulz, & Grueneich, 1993), self-harm, or suicidality (Brodsky et al., 2006). Though these

dynamics among individuals with BPD have been well described, research has not uncovered what factors might influence the presentation of problematic responses to rejection. Such revelations might allow for even better informed interventions for individuals with BPD and those with high rejection sensitivity generally.

Disturbed Relationships as a Core of BPD

Interpersonal disturbance is central to the BPD diagnosis. Intense and unstable relationships, frantic efforts to avoid abandonment and oscillations between idealization and denigration of others underlie the DSM-IV-TR definition of BPD (APA, 2000). Factor analytic studies of BPD psychopathology frequently point to interpersonal disturbance as a core factor of the disorder, distinct from affective instability and impulsivity (Andión et al., 2011; Clarkin, Hull, & Hurt, 1993; Sanislow, Grilo, & McGlashan, 2000). In terms of global social functioning, individuals with BPD experience severe impairment across a number of domains (Hill et al., 2008; Russell, Moskowitz, Zuroff, Sookman, & Paris, 2007). In addition, researchers find BPD patients' day to day interpersonal interactions tend to be more angry, disagreeable, ambivalent and empty, both compared to healthy controls and those with non-BPD personality disorders (Stepp et al., 2009; Russell et al., 2007).

Gunderson (2007) has argued that disturbed relationships in BPD, characterized by angry and aggressive volatility, are partially dependent on high trait rejection sensitivity. Linehan (1995) has also suggested that BPD patients tend to be hypervigilant for social threat cues and signs of rejection. Downey (Downey & Feldman, 1996)

describes RS as a tendency to anxiously expect, have a low threshold for perceiving and a tendency to over-react to rejection. In laboratory tasks, individuals high in RS tend to be hypervigilant for cues of rejection and to feel rejected in response to ambiguous social situations (Downey & Feldman, 1996). Anger in response to perceived rejection is also at the core of RS. Individuals high in RS tend to have greater conflict with their partners following perceived rejection and engage in more hostility in conflictual discussions (Ayduk, Downey, Testa, Yen, & Shoda, 1999; Downey, Freitas, Michaelis, & Khouri, 1998). Sexual abuse, physical abuse and neglect, all highly prevalent amongst BPD patients (Ogata et al., 1990) are also risk factors for high RS (Feldman & Downey, 1994).

Researchers are accumulating support for the importance RS to BPD psychopathology (Limberg et al., 2011; Staebler et al., 2011; Selby, Ward, & Joiner, 2010; Berenson et al., 2011; Meyer, Ajchenbrenner, & Bowles, 2005; Lawrence et al., 2011; Ayduk et al., 2008; Gardner, Qualter, Stylianou, & Robinson, 2010). BPD patients felt more rejected in an ostracism task, even during conditions in which they were included in the task (Staebler et al., 2011), suggesting a perceptual system ready to detect rejection. This is consistent with repeated evidence for perception of threat in neutral images among people with the disorder (Dyck et al., 2009; Scott, Levy, Adams, & Stevenson, 2011; Donegan et al., 2003). Recent research has suggested emotional hyperarousal in BPD is confined to contexts of rejection rather than the presence of other emotional stimuli generally (Limberg et al., 2011). Rejection experiences among BPD patients sparks aversive states of arousal commonly linked to self-mutilation (Stiglmayr et al., 2005). Drug cravings and disordered eating are also prompted in BPD patients by

rejection (Selby et al., 2010; Kruedelbach et al., 1993). Rejection and anger are intimately tied in BPD. Berenson and colleagues (Berenson et al., 2011) found BPD patients evidenced a strong automatic association between rejection and rage. They also sampled day to day experiences using diary methods finding BPD participants reported more instances of at least moderate rage. Analyses revealed rejection experiences frequently triggered these angry feelings. Raw to social spurning, BPD patients are particularly aroused by rejection, leading to aversive emotional states and behaviors that increase their suffering, infect their work life and destroy the relationships that they both yearn for and fear.

Motivational direction and behavioral reactions to threat

This study examines the hypothesis that tendencies toward approach or withdrawal motivation in response to rejection underlie differences in expression of rejection sensitivity among groups high in that trait. We assess motivational direction, using EEG, among healthy individuals, people with BPD, and individuals with major depressive disorder (MDD). Theorists and researchers have discussed motivational direction as a basic underlying component of emotional behavior (Tomarken, Davidson, Wheeler, & Doss, 1992; Sutton & Davidson, 1997; Davidson, Ekman, Saron, Senulis, & Friesen, 1990). Withdrawal motivation, an internal inducement away from unpleasant stimuli, underlies emotions like sadness and disgust (Tomarken et al., 1992). Alternately, approach motivation, an inducement toward stimuli, provides the basic ingredient to positive emotions like joy and love. However, anger, a negative affect, has also been

found to be buttressed by approach motivation (Harmon-Jones, 2003a; Harmon-Jones, Schmeichel, Mennitt, & Harmon-Jones, 2011). Anger has functional implications, motivating the removal of obstacles to rewards or correcting insults or wrongs (Harmon-Jones & Sigelman, 2001). Perceived injustice often sparks outrage and an approach motivation to right the injustice (Harmon-Jones, 2007). Withdrawal motivation has been well documented in individuals with MDD (Stewart, Bismark, Towers, Coan, & Allen, 2010; Gotlib, 1998; Diego, Field, & Hernandez-Reif, 2001; Vuga et al., 2006; Henriques & Davidson, 1990), but appears inconsistent with BPD pathology. While rejection sensitivity is characteristic of both individuals with MDD and BPD, the groups display distinct reactions to rejection which may be explained by differences in motivational direction.

The Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS; Fowles, 1980; Gray, 1970; Gray, 1978; Gray, 1987; Gray, 1990) provide a more thorough conceptualization of the motivational hypothesis. The BAS governs appetitive behaviors and is sensitive to cues of reward, non-punishment, and, importantly, escape from punishment (i.e. negative reinforcement), orienting and engaging behavior towards reward and away from threat, all consistent with approach behavior. The BAS has been linked to feelings of happiness and optimism as well as aggression (Davidson et al., 1990; Sutton & Davidson, 1997; Tomarken et al., 1992). The BIS is a system thought to regulate responses to threat (McNaughton & Corr, 2004). It is a conflict monitoring system which induces anxiety and inhibits behavior when competing motivational goals arise in addition to inhibiting behavior in the presence of punishments.

Much of the research on affect and motivational direction has utilized biological markers of approach and withdrawal measured using EEG. Relatively greater right frontal cortical EEG asymmetry (relatively greater right frontal, compared to left frontal activation) has been supported as underlying withdrawal motivation while relatively greater left frontal cortical asymmetry has been supported to underlie approach motivation (Davidson et al., 1990). Some research has found self-report indices of BAS and BIS are related to greater left and right frontal asymmetry, respectively (Diego, Field, & Hernandez-Reif, 2001; Sutton & Davidson, 1997) though research has more consistently supported the BAS-left frontal asymmetry relationship (Harmon-Jones & Allen, 1997; Coan & Allen, 2003), or even the relationship between BAS and bilateral frontal cortical activation (Hewig, Hagemann, Seifert, Naumann, & Bartussek, 2006). A relationship between BAS and bilateral activation is consistent with a system which promotes active behavior, regardless of motivational direction. This aspect of asymmetry and BAS has yet to be fully resolved empirically, however, research partly limited by the difficulty of accurately measuring the behavioral output of a biological system using self-report.

Approach motivation is not in itself maladaptive. Ample research promotes the benefits of trait approach motivation in healthy populations (Coan & Allen, 2004). Rather, motivation is only an ingredient to emotion and approach has been shown to underlie both negative and positive behaviors. Numerous approach behaviors are indeed problematic. High trait anger, aggression and hostility often lead to difficult consequences in interpersonal relationships, work functioning and legal problems. In addition, because angry individuals are most at risk for self-harm and suicidality,

excessive approach motivation may also lead to self-injury, hospitalizations or completed suicide (Evren, Cinar, Evren, & Celik, 2011; McGirr, Paris, Lesage, Renaud, & Turecki, 2007). Substance abuse is common amongst individuals with high approach motivation (Franken, 2002; Kambouropoulos & Staiger, 2001). Other impulsive behaviors such as binge eating and excessive shopping or gambling are also consistent with approach motivation (Schienle, Schäfer, Hermann, & Vaitl, 2009; Knoch et al., 2006). Thus, rather than simply a signal for happiness and love in healthy populations, approach motivation has the potential to promote deleterious behaviors.

Though not previously explored, BPD is striking in the number of maladaptive approach-related behaviors that are characteristic of the disorder. Among the DSM-IV-TR criterion (APA, 2000), numerous aspects of BPD are consistent with approach: inappropriate anger, substance abuse, binge eating, promiscuous sex and excessive spending. Research also links anger and self-harm and suicidality, suggesting these behaviors are also likely mediated by approach motivation. Even the desperate activities individuals engage in attempting to avoid abandonment, carry with them a strong approach character - they are goal directed bids to keep another person close and avoid the punishment of rejection. Because many of these behaviors are prompted by rejection experiences or other interpersonal stressors, a strong possibility is that individuals with BPD react to rejection with a strong motivation to approach, resulting in damaging behaviors to themselves and others.

EEG asymmetry studies of rejection

There has been a wealth of research on brain function related to the experience of social rejection (e.g., Eisenberger, Lieberman, & Williams, 2003). This includes work detailing the literal pain felt by the ostracized. However, there have been far fewer investigations examining differences in brain function that specifically underlies hostility that may propagate retaliation. Frontal cortical asymmetry is one measure that might elucidate differences in motivational orientation that moderate behavioral reactivity to rejection. The two studies evaluating fontal asymmetry and rejection in healthy participants found left frontal reactions to rejection are associated with approach motivation. Peterson and colleagues (Peterson, Gravens, & Harmon-Jones, 2011) found that when individuals were rejected, relatively greater left frontal activation predicted their reports of anger. They also found that increasing activation in the left frontal lobe by having participants make right-hand contractions before being rejected resulted in more angry responses to the rejection compared to participants who made left-hand contractions (hand movements are processed by the contralateral motor cortex). Seemingly in contrast, Koslov and colleagues (Koslov, Mendes, Pajtas, & Pizzagalli, 2011) have suggested that greater left frontal cortical activation in response to rejection acts as a buffer to threat. They detailed that greater left relative dorsolateral prefrontal activity (measured using source-localization techniques) was associated with increased cardiac output and decreased total peripheral pressure, suggesting a threat buffering effect of greater left frontal activation and approach oriented motivation in response to social threat. However, the authors note the findings could also be indicative of a physiological

profile supporting anger, given others have found anger to be associated with similar physiology (Harmon-Jones, 2003a). Thus, in healthy populations, no evidence has been offered of a motivational tendency in either direction following rejection, though there is evidence that greater anger is associated with approach-related neural activation. Neither study, however, has evaluated groups marked by heightened rejection sensitivity.

Current Study

The current study is a step toward understanding the problematic responses individuals with BPD have to rejection. Although increased rejection sensitivity is considered a key diagnostic feature of BPD, it remains unclear why rejection sensitivity in BPD often leads to a higher risk for interpersonal aggression and hostility, a feature not present in other groups characterized by high rejection sensitivity, like MDD. Better understanding of neural influence on behavioral responses to rejection in BPD would add to the building appreciation of interpersonal difficulties and problems with rejection in the disorder. We hypothesized that individuals with BPD would demonstrate greater levels of hostility following rejection compared to individuals with MDD and healthy controls (HC). In addition we hypothesized that individuals with BPD would demonstrate greater left frontal activation following a rejection, consistent with approach motivation. We tested these hypotheses by evaluating EEG asymmetry at baseline, following a rejection experience and after given an opportunity to enact hostility on another person.

Chapter 2

Methods

Participants

Participants were 62 right-handed, female participants between the ages of 18 and 60 (BPD =24, MDD = 16, HC=22). Patient characteristics are detailed in Table 1. BPD and MDD participants were recruited from a university-based outpatient community mental health clinic at The Pennsylvania State University. Through advertisements, we identified healthy control (HC) participants among community residents and University students. In order to match comparison patients with clinical participants on demographic variables, we selected potential HC participants based on age and education. Prospective participants were telephoned by a project manager who assessed appropriateness for inclusion. Participants not meeting exclusion criteria were enrolled in diagnostic interviews.

For the BPD group, we excluded patients who experienced a major depressive episode within the last six months or who met diagnostic criteria at any point for psychotic disorders, bipolar I disorder, delirium, dementia, history of moderate to severe brain injury, and/or mental retardation. For the MDD group, we included individuals with current or partially remitted major depression, all of whom were required to be currently in treatment for depression. We excluded potential MDD participants who met for more than two cluster B personality disorder criterion on the IPDE or who met diagnostic

criteria at any point for psychotic disorders, bipolar I disorder, delirium, dementia, history of moderate to severe brain injury, and/or mental retardation. Thirteen of the participants met criteria for current depression, and three met criteria for partially remitted depression. Previous research indicates that EEG asymmetry patterns do not differ between individuals with full MDD versus remitted (Gotlib, 1998; Henriques & Davidson, 1990; McFarland, Shankman, Tenke, Bruder, & Klein, 2006; Stewart et al., 2010; Vuga et al., 2006). For the HC group, we excluded participants with current or past DSM-IV-TR Axis I or II diagnoses, suicidal or self-injurious behaviors or who met more than two DSM-IV-TR criteria for BPD, or history of moderate to severe traumatic brain injury or other neurological disorder. Among all participants, we excluded individuals who were pregnant, were left handed or had a significant medical illness.

All participants were evaluated using the Structural Clinical Interview for DSM-IV (SCID-I; Frist 1997) and the International Personality Disorder Examination (IPDE; Loranger 1997). Doctoral level therapists trained to reliability in using both measures evaluated potential participants. Diagnoses were confirmed in a LEAD standard meeting with all research personnel, supervised by a licensed clinical psychologist. In previous studies, we have documented an interrater reliability of kappa = .88 in patients with BPD (Scott, Levy, & Granger, *in press*).

Of the 24 BPD patients, 14 were on antidepressants, 4 were taking lose dose anti-psychotics, 6 were taking anxiolytics and 8 were taking mood stabilizers. Among the MDD group, 6 were taking antidepressants, one was taking a low-dose antipsychotic, one was taking an anxiolytic and one was taking a mood stabilizer. All clinical participants were in psychotherapy. Participant groups differed in the classes of psychotropic

medications they used. Chi-square analyses revealed BPD participants were more likely to be taking medications across each of the drug classes compared to the HC or MDD group.

Research Design

Participants were informed of the laboratory tasks during the consenting procedure. They were told that the study was designed to understand how the brain processes basic social interactions. EEG was continuously recorded throughout the experiment. However, analyses are only presented from baseline periods of rest, consistent with previous research (Verona, Sadeh, & Curtin, 2009) and in order to keep movement artifact to a minimum. An initial 8 minute baseline was collected while participants sat quietly alternating between 1-min epochs with eyes-open and eyes-closed. We collected additional two-minute epochs after the social rejection task and after the retaliation task (see below). The order for eyes open/eyes closed was counterbalanced across participants. All EEG data was collected in a sound-attenuated room. Researchers were outside of the room and communicated with the participant by intercom.

Social Rejection Task

Following baseline, participants engaged in the Cyberball ball toss task (Williams, Cheung, & Choi, 2000). The task presents two avatars and pictures of supposed other

participants on the upper left and right of the display. An avatar representing the actual participant is presented in the bottom center of the screen with the participant's picture. Participants were told that the other players were in EEG labs in the basement of the same building. The lead investigator made a scripted declaration that they "needed to check on how they were doing downstairs" while impedances were being checked. While participants believed the task involved playing with other people over a network connection, the game was actually programmed so participants were included for 21 throws (had a 50 percent chance of being thrown to on each trial), partially excluded for 21 throws (had a 25 percent chance of being thrown to on each trial) and then were excluded for an additional 21 throws. The task ran close to 6 minutes. Participants made throws to other participants by button press. After completing the Cyberball task, we collected two minutes of EEG alternating between eyes open and eyes closed for one minute each.

Hostile Retribution Task

Participants engaged in a task to assess their hostility towards one of the players who had rejected them. Participants were told they would be playing the game with one of the people from the Cyberball task. The researcher reading the task instructions would change the instructions midstream to say "you will be playing with a person from the previous task...I think it's the girl from the last task, Cassie". We slightly modified a task used in past research to assess hostility (Peterson, Shackman, & Harmon-Jones, 2008). During each trial a fixation cross was proceeded by a plus sign either on the right side of

the screen or the left side of the screen. Correct responses required the participant to press one button if the plus sign was on the left and another if it was on the right. The participant was told that whomever was fastest to respond correctly would win that round and be allowed to deliver noise to the other person. We scripted the program such that the participant automatically won some trials and lost others. The task was designed to measure base levels of hostility and later to assess reactive aggression. For the first 8 trials, the participant lost only once and was delivered minimal noise (60db for 5 sec). In the last two blocks of trials, the participant lost 8 of 10 times and received louder noise blasts (100db for 9 sec). We structured the task in this way in order to allow examination of aggression initially without hostile provocation by the other participant. Prior to the start of each trial, the participant dialed in their choice for how loud they would like the noise to be if they were to win the trial (60-100db). After winning trials, they indicated how long they would like the noise blast to be by selecting between 1 and 9 seconds. We separated the two decisions about the noise blasts for a purpose. We conceptualized the first decision as a lower BAS state and the second as a higher BAS state. The loudness decision is made distal to the noise blast when it is uncertain whether the blast will be delivered, while the duration decision is made proximal to the noise blast, after a winning trial, when there is certainty the opponent will be blasted. Following this task, we again collected two minutes of EEG alternating between eyes closed and eyes open.

Participants were carefully debriefed after the completion of the study to assess their belief in the cover-story. In addition, participants were asked questions following the rejectrion task which subtly probed their beliefs about the task (e.g., ‘Though the others were not in the same room as me, I felt like I was playing the game with real

people rather than cartoon characters'). Participant responses and ratings both revealed a great degree of believability for the task.

EEG data collection and analysis

We recorded EEG using a 128-channel Electrical Geodesic Sensor Net (Electrical Geodesics, Inc., Eugene, OR) amplified 30,000 times by an EGI Netamps 200 system. Two electrooculogram (EOG) channels were recorded (vertical channels above and below the eye orbit and horizontal at the outer canthi). Data were digitized at 256-Hz on an Apple Mac Pro computer. Impedances were kept below 50 K-Ohms. EEG data were acquired online with Cz as a reference site and were later referenced offline to the average of all EEG leads.

We visually scored and edited the EEG to remove artifacts due to gross muscle activity and movement. Eye blinks were removed using Independent Components Analysis (ICA). The data were filtered using a high-pass (.1 Hz), low-pass (100 Hz) and notch filter (60 Hz). Data were segmented into 1-min blocks and further segmented into 1.024 s epochs overlapped by 75 percent and subjected to a Fast Fourier Transform. We extracted artifact-free epochs through a Hamming window. Power density ($\mu V^2/Hz$) was computed for the alpha band in the range of 8-13 Hz. All power density values were natural log transformed in order to normalize the data distribution. Asymmetry scores were calculated by subtracting the natural log-transformed scores (ln[right]-ln[left]) for each of the following homologous left and right pairs: F1/F2, F3/F4, F5/F6, F7/F8, Fp1/Fp2. Differences in alpha values (right electrode minus left electrode) were averaged

over these five pairs. EEG asymmetry consisted of an average of 5 right frontal electrodes subtracted from the average of 5 left frontal electrodes. Montages, rather than individual electrodes were used in order to prevent data loss due to needing to reject overly noisy channels and to partially take advantage of the greater number of electrodes on the high-density net. Because alpha activity is the inverse of neural function (Ray & Cole, 1985), more positive values reflect greater left activity (greater right than left alpha).

Measures

Prior to fitting participants with an EEG net, they completed a packet of measures assessing depression, trait aggression, and behavioral inhibition and activation. Participants completed questionnaires regarding state positive and negative affect and state hostility at baseline, after the cyberball task and again after the hostility game.

Depression Measure

The Beck Depression Inventory-II (BDI-II;Beck 1996) is widely used as a self-report measure for screening depressive symptoms. Participants use a Likert-scale (0-3) to indicate the severity of depressive symptoms they may have experienced in the past two weeks. Total scores above 13 are typically considered to suggest at least mild depression. Depression was assessed in order to determine whether depressive symptoms account for the EEG asymmetry findings and to help characterize the participants.

Trait Aggression Measure

Participants self-reported trait aggression using the Buss-Perry Aggression Scale (Buss & Perry, 1992), a 29-item Likert-scale measure. We included this measure in order to determine differences in trait aggression amongst the groups as well as to validate the measure of behavioral hostility. In addition, we used this measure to clarify EEG asymmetry findings.

Behavioral Inhibition/Behavioral Activation Measure

The BIS/BAS scales (Carver & White, 1994) are thought to measure motivational systems theorized to underlie human behavior: the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS). BAS is thought to mediate appetitive and approach oriented behaviors while BIS is theorized to regulate withdrawal motivation. We included this measure in order to compare the present EEG asymmetry findings with past data.

State Affect Measure

Participants completed The Positive and Negative Affect Schedule - Expanded Form (Watson & Clark, 1999) at baseline, following the Cyberball task and after the Hostility Task. The measure was used to track changes in emotional experience throughout the tasks.

Analytic Strategy

To examine the impact of the experimental tasks on participant affect, we first examined self-report positive and negative affect and anger over the course of the study, using repeated measures ANOVA.

Next, to determine whether group differences were present in hostility evinced on the hostile retribution game, we conducted an ANOVA on four different metrics. We examined differences in both the loudness and duration of noise blasts participants chose. We conceptualized these two as distinct metrics. The loudness was chosen prior to each trial, while duration was only chosen after winning trials. Prior to each trial, participants are faced with greater uncertainty and likely heightened anxiety and tension regarding the upcoming trial, more consistent with a high BIS state. Following winning trials, reward, and immediate retribution primes a higher BAS state [cite beauchaine, etc.]. In addition to examining all trials, we examined the first two blocks (8 trials) of the hostility task, and the following 3 blocks (12 trials) separately. In the first two blocks, the computer script delivers little noise to participant. This suggests we can assume that hostility shown by the participant in these trials is retribution for rejection in the previous task. Given participants were blasted with louder and longer white noise in the subsequent blocks, hostility in these blocks may be in reaction to either rejection or the noise blasts.

Using repeated measures ANOVA, we examined group differences in relative frontal asymmetry at three time points (baseline, post-cyberball, post-hostility task). Group differences in overall frontal alpha values as well as individual left and right

frontal alpha values were examined. An image of the task progression is provided in Figure 1.

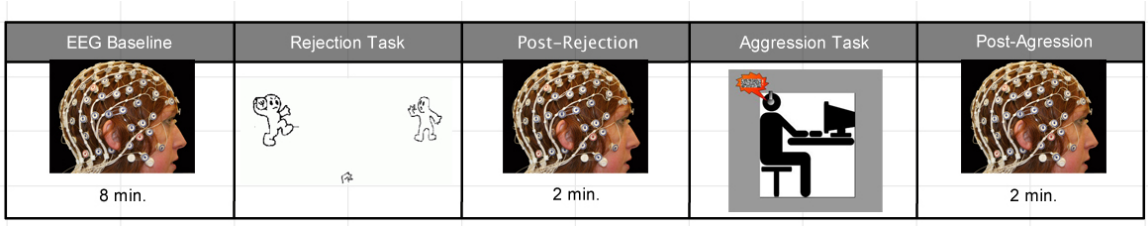


Figure 1. Task Progression. The study began with 8-minutes of baseline EEG. This was followed by the Cyberball rejection task and two minutes of resting EEG. The study ended with the aggression task followed by another two minutes of resting EEG.

Finally, in order to examine associations between EEG Asymmetry and self-report measures, correlations between these variables were run. In all instances, post-hoc tests were Tukey's HSD.

Chapter 3

Results

Self-Report Trait Group Differences

See Table 1 for means.

Table 1
Sample Characteristics

Characteristic	BPD (N=24)	HC (N=22)	MDD (N=16)
Age (years)			
M	31.96	27.78	33.12
SD	9.13	11.64	8.99
Education N (%)			
High school	8 (33%)	5 (23%)	3 (19%)
Some college	6 (25%)	11 (50%)	4 (25%)
College graduate	8 (33%)	4 (18%)	7 (44%)
Postgraduate	2 (8%)	2 (9%)	2 (13%)
Marital status N (%)			
Single	14 (58%)	16 (73%)	7 (44%)
Married/cohabiting	4 (17%)	5 (23%)	6 (38%)
Divorced	6 (25%)	1 (5%)	3 (19%)
Ethnicity (%)			
Caucasian	18 (75%)	16 (72%)	14 (88%)
African American	5 (21%)	2 (9%)	1 (6%)
Latino/Latina	1 (4%)	1 (5%)	1 (6%)
Asian/Pacific Islander	0 (0%)	3 (14%)	0 (0%)

Note. No group differences existed for any sample characteristics. BPD = Borderline Personality Disorder. HC = Healthy Control. MDD = Major Depressive Disorder.

Trait hostility

We evaluated between-group differences in a number of self-report traits. For trait hostility, measured by the Buss-Perry scale, ANOVA showed a main effect of group, $F(2, 59) = 10.90$, $p < .001$, $\eta^2 = .27$. Post-hoc tests revealed the BPD group was significantly higher in trait aggression than the MDD, $p < .005$ or HC groups, $p < .001$.

Rejection sensitivity

Differences in rejection sensitivity were assessed using the Rejection Sensitivity Questionnaire. ANOVA revealed between group differences $F(2,59) = 5.99$, $p < .005$, and post-hoc tests revealed that the BPD group was more rejection sensitive than the HC group, $p < .005$. The MDD and HC groups did not differ in Rejection Sensitivity $p = .11$, though was likely due to an issue of low power. The MDD and BPD groups were not significantly different in terms of Rejection Sensitivity $p > .5$.

BIS/BAS

Differences in self characterization of BIS and BAS were also assessed. Groups did not differ on BAS scores, $p > .5$, however, the MDD and BPD groups both showed higher BIS scores compared to the HC group $F(2,59) = 7.43$, $\eta^2 = .20$, $p < .001$, Tukey HSD, ps = .007 & .004. The BPD and MDD groups did not differ in terms of BIS.

Depressive symptoms

Groups differed in self-report of depressive affect measured by the BDI-II $F(2,59) = 24.23$, $p < .001$, $\eta^2 = .44$. Both the BPD, $p < .001$, and MDD , $p < .001$groups reported more depressive symptoms than the HC group. BPD and MDD BDI-II scores were not significantly different $p > .9$.

Group differences in EEG asymmetry

To examine the relationship between group and frontal EEG asymmetry, we ran a repeated measures ANOVA on frontal asymmetry using averaged frontal montages, again with group and task as the independent variables. There was a main effect of group, $F(1,59) = 4.070$, $p < .05$, $\eta^2 = .12$ and a time by group quadratic interaction $F(2,59) = 4.19$, $p < .05$. To unpack this interaction, ANOVAs were run at each time point to determine whether differences in EEG asymmetry could be detected. A significant difference was present following the rejection task $F(2,59) = 8.09$, $p < .001$, $\eta^2 = .22$, but not at baseline, $p = .29$ or post-hostility, $p = .39$. Planned t-tests evaluating this apriori hypothesis were run to examine differences between the BPD group and the HC and MDD groups following the Cyberball task. The BPD group showed significantly greater left frontal asymmetry compared to the healthy control group $t(44) = 2.98$, $p < .005$ and the MDD group $t(38) = 3.44$, $p < .001$. A graph of these EEG asymmetry power density values is displayed in Figure 2.

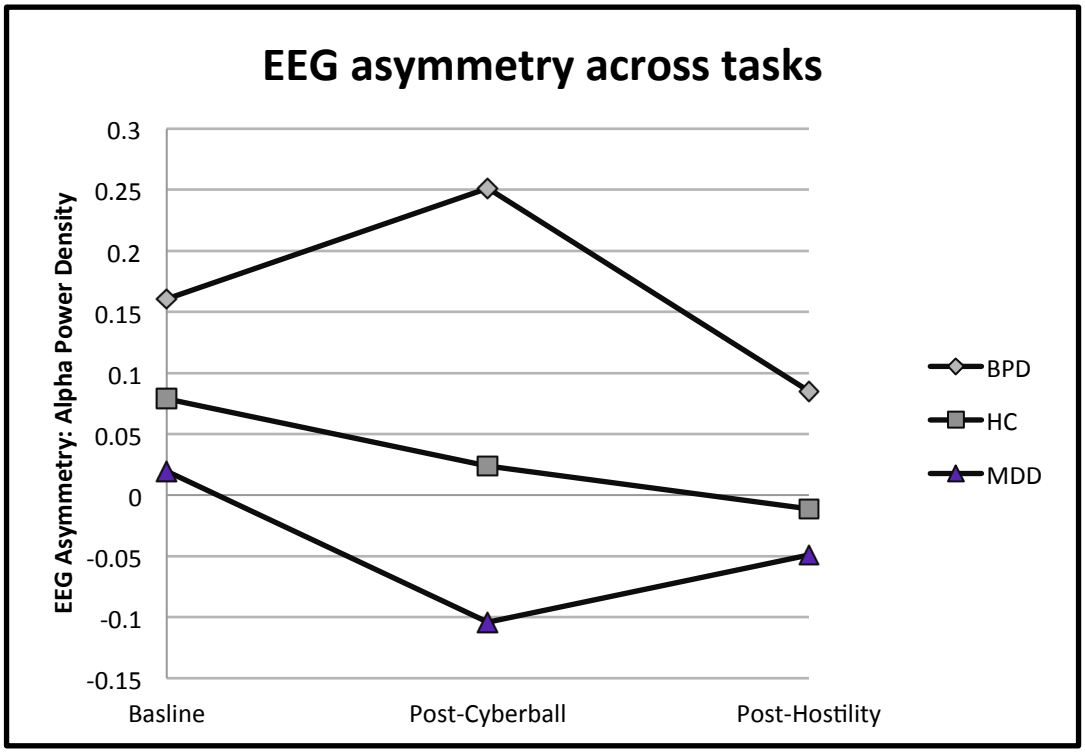


Figure 2. EEG asymmetry across tasks. Differences in EEG asymmetry over three time-points, Baseline, Post-Cyberball and Post-Hostility. The BPD displayed significantly more leftward asymmetry following rejection compared to both groups. The HC and MDD groups were not significantly different at any time point.

Because mood stabilizers were more prevalent among the BPD group we evaluated point biserial correlations between use of four medication classes (antidepressants, antipsychotics, mood stabilizers and anxiolytics) and EEG asymmetry at all time points separately. Of these 12 correlations, only the relationship between mood stabilizers and EEG-asymmetry post-rejection was significant, $r(60) = .33$, $p < .05$. In addition, we examined differences in EEG asymmetry post-rejection between the 16 BPD participants not using mood stabilizers and the 8 who were using them. The difference was not significant and the estimate of effect size small, $F(1,21) = 0.52$, $p = .481$, $\eta^2 = .024$ We re-ran the repeated measures analysis on EEG asymmetry across tasks, using the

mood stabilizer factor as a covariate. The time by group quadratic interaction remained significant, while the main group effect dropped below significance $p = .108$.

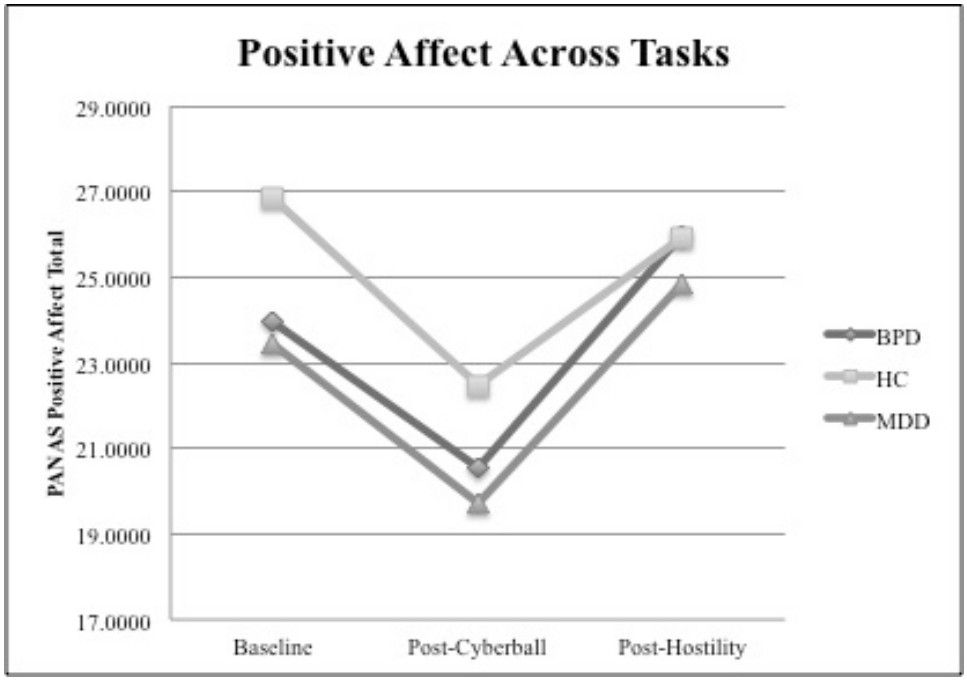
Because we included both participants meeting full criteria for depression, and those with partially remitted depression, we ran analyses for EEG asymmetry following cyberball after dropping the 3 participants with a MDD partial remission diagnosis. Results remained significant when evaluating only those with full criteria for MDD.

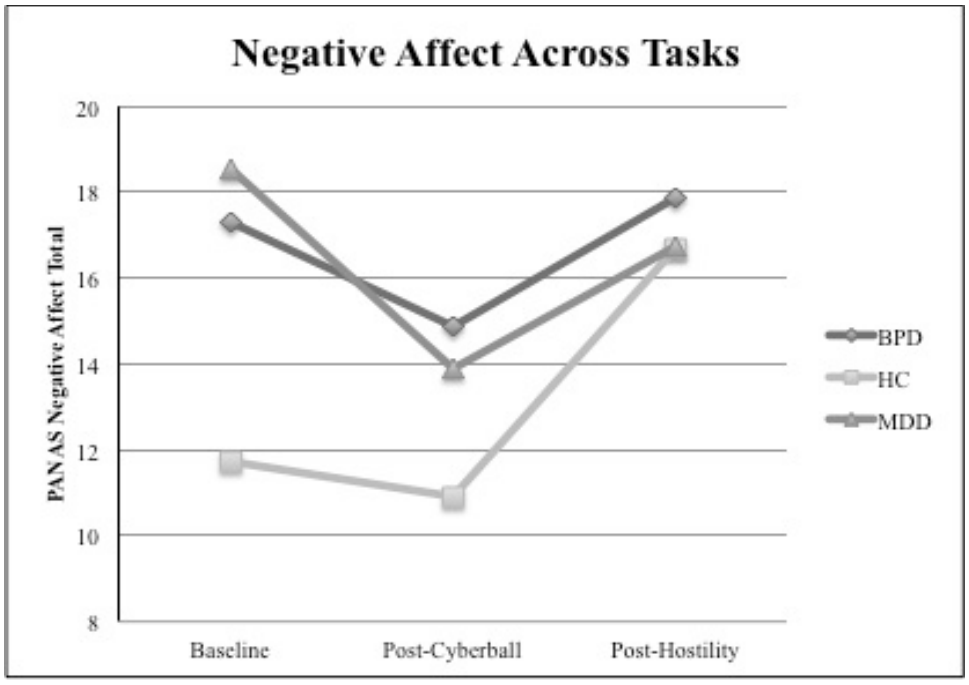
In order to verify that the frontal asymmetry pattern was not general to the whole brain, we evaluated group differences in cortical asymmetry utilizing occipital electrodes (O2/O1), where we would not expect group differences in asymmetry. This repeated measures ANOVA revealed there was no effect of group, task, or group x task. In addition, to verify that only the frontal asymmetry was correlated with expected variables theoretically and empirically linked to approach motivation, we examined relationships between occipital asymmetry and trait anger, rejection sensitivity, BDI-II scores, BIS, BAS and behavioral hostility. No significant relationships emerged. Occipital asymmetry was also unrelated to frontal asymmetry.

Emotional changes due to rejection and aggression

Using a repeated measures analysis of variance (ANOVA) we examined self-ratings of emotion over the course of the experiment. There was a main quadratic effect of task on positive affect, $F(2,58) = 10.14$, $p < .001$, $\eta^2 = .27$, but no group differences or task x group interaction. Positive affect was lower after the Cyberball task compared to both baseline $t(61) = 4.32$, $p < .001$ and following the aggression task $t(61) = 4.47$, $p <$

.001. Positive affect was not significantly different when comparing baseline and after the aggression task. There was also a main quadratic effect of task on negative affect $F(2,58) = 12.48$, $p < .001$, with participants reporting decreased negative affect following the rejection experience compared to baseline $t(61) = 3.190$, $p < .01$ and post-hostility $t(61) = 2.09$, $p < .05$. There was also a significant effect between groups, $p = .05$, driven by lower negative affect at baseline for the HC participants compared to each of the other groups, corrected using Tukey-HSD. There was no effect of task on self-reported feelings of anger $p > .05$, though a significant group effect emerged $F(2,58) = 3.46$, $p < .05$. Evaluating post-hoc tests, the BPD group reported significantly more hostility overall compared to the HC group, $p < .05$. See Figure 3.


Positive Affect Across Tasks
29.0000
27.0000
25.0000
23.0000
21.0000
19.0000
17.0000
PANAS Positive Affect Total
Baseline
Post-Cyberball
Post-Hostility
BPD
HC
MDD


Negative Affect Across Tasks
20
18
16
14
12
10
8
PANAS Negative Affect Total
Baseline
Post-Cyberball
Post-Hostility
BPD
HC
MDD

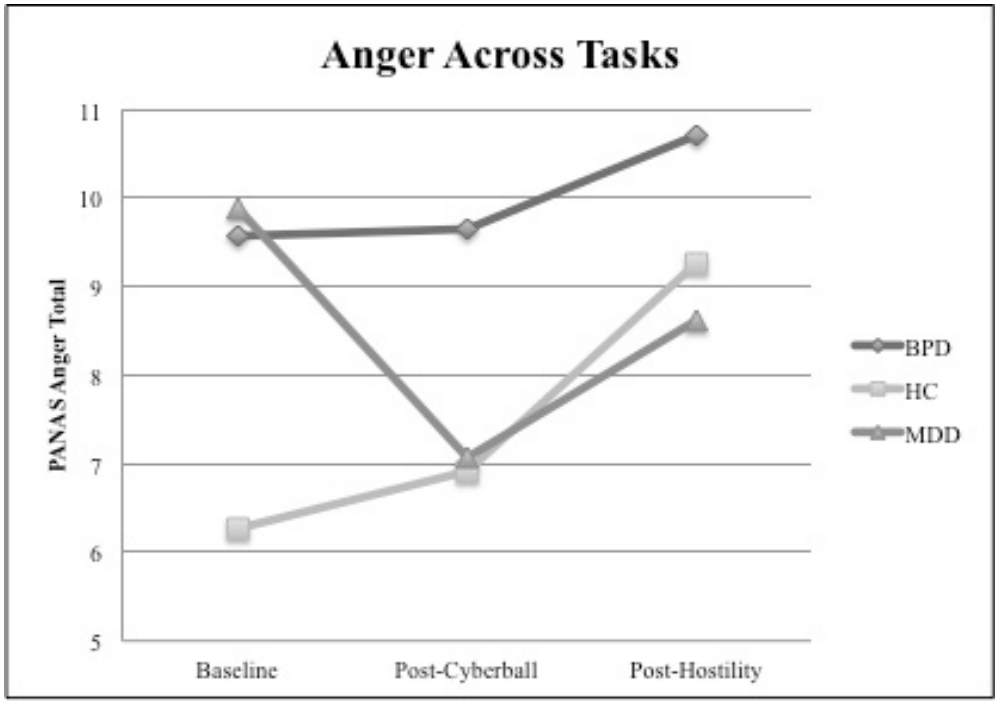
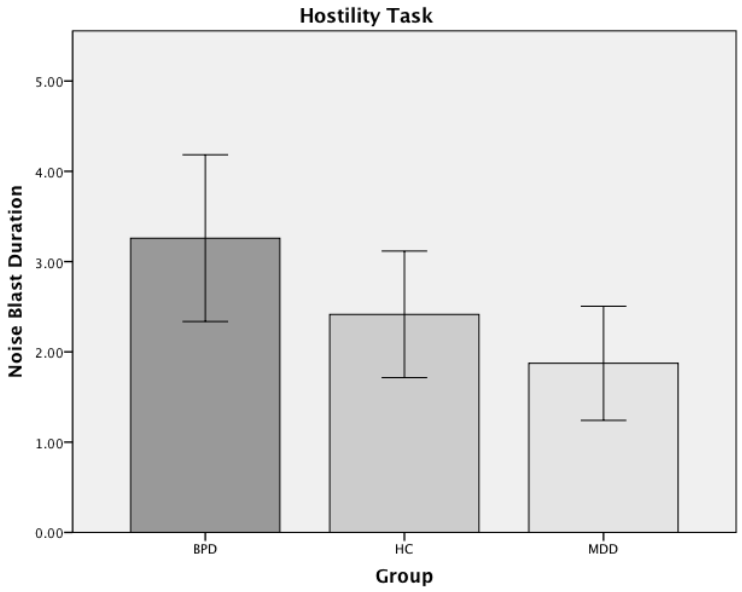


Figure 3. Self-report group means of affect over three time points during the task, measured by the PANAS. Collapsing across groups, positive, $F(2,58) = 10.14$, $p < .001$, $\eta^2 = .27$, and negative Affect, $F(2,58) = 12.48$, $p < .001$, were both lower following rejection. The HC group reported less negative affect overall. The BPD group reported more anger overall.

Hostility

ANOVA was used to assess differences in the hostility displayed during the retribution task. Groups did not show significant differences in the of the loudness of noise they chose to deliver prior to each trial $F(2,59) = 1.76$, $p = .181$, though the BPD group showed a non-significant trend toward louder noise blasts compared to the MDD group $t(38) = 1.69$, $p = .099$. However, groups differed in the duration of the noise they chose to deliver following winning trials $F(2,59) = 4.36$, $p < .05$. The BPD group delivered significantly longer noise blasts compared to the MDD group, $t(38) = 2.33$, $p < .05$, but not the HC group. Examining just the first 8 trials, prior to larger noise blasts from their opponent, individuals with BPD also provided longer noise blasts than individuals with MDD, $p < .05$ as well as trending toward delivering significantly longer noise than the HC group $p = .085$. Means are for all trials are presented in Figure 4.



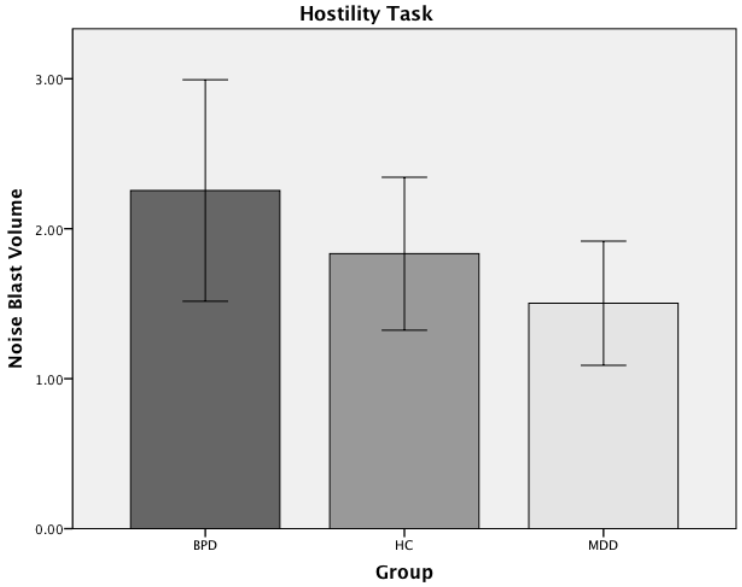


Figure 4. Hostility task results for first eight trials. Error bars represent 95% Confidence Intervals. The BPD group gave significantly longer noise compared to the MDD group and trended toward greater volume than the MDD group. Scale for noise blast duration was 1 to 9 seconds. Scale for noise blast volume was 1 to 5, with 1 equal to 60 decibels and 5 equal to 105 decibels.

Correlations with EEG asymmetry

Given greater left frontal asymmetry has been both associated with psychological health (Davidson, 2003) as well as trait anger (Harmon-Jones, 2003b) we evaluated correlations between EEG asymmetry and relevant constructs.

Retaliatory aggression and EEG asymmetry

Assessing all 3 groups, EEG asymmetry did not predict retaliatory aggression, $p > .1$. However, because the MDD group provided minimal levels of aggression overall, we also assessed the relationship between EEG asymmetry and aggression while excluded MDD participants. EEG asymmetry predicted both volume of noise blasts $r(46) = .29$, $p = .05$ and duration of noise blasts $r(46) = .30$, $p < .05$.

Trait hostility and EEG asymmetry

Trait hostility, measured by the Buss-Perry scale, was related to EEG asymmetry post-Cyberball when all participants were included in the analysis, $r(63) = .35$, $p < .005$. We also examined group-specific correlations. For the BPD group trait hostility was associated with greater left frontal asymmetry at baseline $r(23) = .50$, $p < .05$, and demonstrated a strong effect size and trend after the Cyberball task $r(23) = .38$, $p = .076$. For the MDD group greater trait hostility was associated with greater left frontal asymmetry at baseline $r(15) = .71$, $p < .01$ but not other time points. There was no

relationship between trait hostility and EEG asymmetry at any time point for the healthy control group.

BIS/BAS and EEG asymmetry

Consistent with previous research, BAS was related to asymmetry post-Cyberball $r(63) = .25$, $p < .05$, and post-hostility $r(63) = .39$, $p < .005$. However, BIS was not related to EEG asymmetry.

Chapter 4

Discussion

We sought to evaluate the role of motivational direction, indexed by EEG asymmetry, in maladaptive behaviors amongst individuals high in rejection sensitivity. Consistent with diagnostic features of BPD, individuals with BPD demonstrated greater hostility, evidenced as longer durations of aversive noise blasts to an opponent, compared to the MDD group after being rejected. Furthermore, EEG asymmetry measures revealed support for the hypothesis that greater left asymmetry differentiates between rejection sensitivity in BPD compared with MDD. Participants with MDD evidenced an increase in right frontal activation post rejection, consistent with past findings relating right asymmetry to greater depressive affect (Henriques & Davidson, 1990; Harmon-Jones & Allen, 1997; Tomarken et al., 1992). In contrast, those with BPD evidenced a significant increase in left asymmetry, consistent with diagnostic profiles of anger in response to rejection, as well as participants' behavior in the subsequent retaliation task. Comparison participants, in contrast, demonstrate less reactivity to task condition with regard to asymmetry.

Though the MDD and BPD groups were equivalent on a number of metrics including BDI scores, Rejection Sensitivity and BIS and BAS scores, they exhibited differences in neural response to rejection. The present findings suggest that individuals with BPD and MDD are not differentiated by rejection sensitivity, but rather by the motivational state following rejection. EEG asymmetry measures suggest that while

individuals with MDD respond to rejection with a motivation to withdrawal, individuals with BPD respond with a motivation to approach. This discrepancy in EEG asymmetry between the groups is consistent with symptoms related to each disorder. Researchers have consistently found that sadness and depression are associated with relatively higher right frontal activation. Depressed patients are likely to turn inward in response to social stress, personalize it and withdrawal (Nezlek, Kowalski, Leary, Blevins, & Holgate, 1997). BPD patients tend to become angry in response to rejection, a state supported by approach motivation. But other BPD behaviors are consistent with an active, approach-oriented state following rejection, such as substance abuse, self-harm, suicidality, and numerous behaviors focused on obtaining rewards and escaping punishment. Though both higher in rejection sensitivity than healthy controls, individuals with BPD and MDD demonstrate different response trajectories both neurally and behaviorally after social rejection.

Individuals with BPD did not show a clear approach motivation at baseline; rather, this state appeared to be prompted by a mild experience of rejection. Coan and Allen (Coan, Allen, & McKnight, 2006; Coan & Allen, 2004) have argued that it is really in response to affective challenge that individual differences in EEG asymmetry are most salient and most reveal differences in affective coping. The current results are consistent with this argument. The specific context in which leftward EEG asymmetry was expressed by individuals with BPD is also consistent with literature that many of the maladaptive behaviors and aversive affective states experienced by individuals with BPD are in response to interpersonal stressors. A recent study found defensive motivation in BPD was evident only in the context of stimuli related to rejection rather than emotional

cues generally (Limberg et al., 2011). Berenson and colleagues (2011) recently reported evidence that rejection experiences amongst individuals with the disorder prompts anger and rage. The current findings, however, expand upon this to suggest that rejection prompts a motivational state in individuals with BPD in which any variety of active approach behaviors is more likely, in addition to anger. With further research, this may help explain numerous behaviors characteristic of BPD, including factors prompting increased substance abuse or self-harm. Selby and colleagues (Selby et al., 2010) found evidence that rejection in BPD was related to binge eating and Krudelbach and colleagues (Kruedelbach et al., 1993) found evidence that rejection prompts drug cravings in individuals with BPD. Both of these behaviors, common in BPD patients, have been shown to be linked to approach motivation (e.g., Franken et al.; Shienle et al., 2009). In addition, rejection is a major precipitant to self-harm, sometimes, tellingly, called auto-aggressive behavior (Klonsky, Oltmanns, & Turkheimer, 2003). Researchers find two main motivations for self-harm are negative reinforcement (removing something punishing, such as emotional pain or aversive tension) and positive reinforcement (obtaining a reward, for instance the high of opiod release), both of which fit well with the approach model presented here. Thus, evidence is accumulating suggesting that rejection appears to be particularly difficult for individuals with BPD, in the present study prompting a motivation to approach aggressively.

Relatedly, the current study may highlight one factor influencing disturbed relationships among individuals with BPD. Numerous research studies document hostility as a major dynamic in relationships amongst BPD patients (Bouchard & Sabourin, 2009; Berenson et al., 2011; Critchfield et al., 2008; Bouchard, Sabourin, Lussier, &

Villeneuve, 2009; Stepp et al., 2009), however getting to the "why" beyond such characterizations is elusive. Here, we find a tendency toward approach motivation may be one factor in hostility in relationships among individuals with BPD. Excessive approach motivation following rejection is likely to be highly maladaptive within relationships, resulting in rage, difficulties disentangling from arguments, showing up at another's work or home unannounced, or calling excessively. Gunderson (2007) proposed two potential factors related to disturbed relationships in BPD: impaired mentalization and rejection sensitivity. Combining a tendency to anticipate threat in interpersonal relationships and difficulties adequately understanding emotions and behaviors in terms of mental states is likely to prompt embroiled, highly chaotic and defensively aggressive behavior in relationships among individuals with BPD, even when clear threats are not present, consistent with clinical and research accounts (Bouchard & Sabourin, 2009; Brodsky et al., 2006; Modestin, 1987; Morse et al., 2009; Russell et al., 2007; Stepp et al., 2009). Helping individuals with BPD improve interpersonal relationships may be dependent on improved mentalization and decreased approach following interpersonal stress.

As noted earlier, an extensive literature points to the protective nature of a mild approach motivation in healthy individuals (e.g, Tomarken et al., 1992). Approach in response to rejection, may, however, be maladaptive. Rather, a more balanced mix anxiety, caution and vigilance for clues as to whether to approach or withdrawal, appears to be a more adaptive response to rejection, allowing for possibilities of both reconnection and protection if needed. Some evidence suggests that when healthy individuals are rejected, they cautiously attend to social information for signs of connection with others (Baumeister & Leary, 1995). A prototypical adaptive response

may be a mix of both cautiously evaluating the possibility of connection, while avoiding further rejection either through defensive or withdrawal reactions. Thus, post-rejection healthy individuals tend to be in a hesitant state characterized mainly by behavioral inhibition. Individuals with BPD do not show the same BIS engagement. Rather, our data suggests they engage the behavioral activation system. The results appear to provide a clear delineation between the groups following rejection in terms of the biological marker used; individuals with BPD show a motivation to reflexively approach, and the healthy individuals showed no strong motivation pull. The excessive approach orientation and the specific style of approach of individuals with BPD appear likely to insure further rejection. Individuals with BPD often lack appropriate strategies for approach, tending to express aggression and extreme neediness. Approach among individuals with BPD may often be an effort to preemptively avoid the punishment of rejection. Subtle cues of rejection, for instance a romantic partner not answering their phone, may prompt a strong approach motivation characterized by anger or desperation. This is likely to have evolved over time as a consequence of the transactional interactions between enhanced motivational response to threat and early exposure to stress and victimization that serves to shape the specific manifestations that characterize BPD pathology. Thus, in response to threat, whereas healthy participants appear to engage a reflective, more evaluative system, seeking to examine the most fruitful response, individuals with BPD appear to rigidly engage in anger and other approach behaviors.

Emotional Responding

Self-reported positive and negative emotion was affected by the rejection task for all groups with a tendency toward both low positive and low negative affective states. Though a decrease in negative affect may appear odd following rejection, a recent meta-analysis (Blackhart, Nelson, Knowles, & Baumeister, 2009), evaluating 192 studies revealed rejection is characteristically followed by both low positive and negative affect. One theory for this observed effect is that following rejection, individuals may experience an emotional numbing. Regardless of the accuracy of this account, it is interesting to note that there was little difference among the three groups in self-report of positive and negative affect. This suggests that healthy people, people with BPD and people with MDD share similar emotional experience, at least in terms of positive and negative affect (such as feeling sad, sluggish, down, or disgusted with oneself). However, individuals with BPD experienced more anger overall. These findings are somewhat at odds with Lawrence and colleagues (Lawrence et al., 2011) assessment of emotion in young BPD patients using the same Cyberball task. While the researchers found the groups to differ in terms of anger, they also found emotional differences throughout the study on a variety of negative emotions. None of the negative emotions assessed in the Lawrence study (anger, disgust, fear, sadness, rejection, shame, emptiness, suicidality, dissociation, suspicion or guilt) are contained within the PANAS negative affect scale, however. Thus, the differences may be due to the use of single items used to evaluate each emotional state, the assessment of different emotional states, and perhaps assessing teenage and young adult patients with BPD rather than adults.

Aggression and Behavioral Activation in BPD

The BPD group evidenced more aggressive responding when given the opportunity to blast supposed participants who had rejected them, particularly in contrast to depressed patients. Using all of the trials of the task, individuals with BPD showed a trend toward sending louder noise blasts to an opponent compared to MDD participants, though they delivered significantly longer noise blasts compared to the MDD group. Using just the initial eight trials of the task, in which the participant was only blasted once with minimal noise, the BPD group delivered significantly longer noise blasts than the MDD group and trended toward longer noise blasts compared with the HC group. We conceptualized aggression on these initial eight trials as aggressive retribution carried over from the previous rejection task, while the following trials were a mix of retribution and aggressive retaliation for aggressive acts enacted by the supposed partner. Differences were somewhat stronger when assessing the initial retribution trials compared to the entire task, perhaps suggesting groups were more uniform in providing longer noise blasts to opponents blasting them, but the BPD group was more distinct in their delivery of longer noise blasts in initial trials. This may indicate differing social norms about the appropriateness of hostility without provocation or greater retribution in response to being rejected in the previous task. In addition, we conceptualized the duration condition as more clear BAS context in which individuals with a greater approach motivation would tend to act more aggressively. We modified the typical order of the aggression task by having participants' select loudness before each trial and select duration of the noise blast after the trial. Thus, the loudness selection was done distal to the delivery of the

noise, when it was uncertain whether the noise would be delivered. The duration selection was made after a winning trial, a BAS reward context, proximal to the delivery and under a condition of certainty. It is not surprising, then, that group differences were best revealed in this condition.

We found that EEG asymmetry post-rejection was associated with more aggressive responding on the retribution task. This was only found, however when dropping the MDD group from the analysis. Both the BPD and HC group evidenced a similar effect size in the relationship between EEG asymmetry and aggression (r~.29). The reason the MDD group did not show this same relationship is likely due to a floor effect. A large proportion of the MDD group selected to deliver minimal noise. The relationship between EEG asymmetry and aggression among the BPD and HC groups is consistent with previous research on the aggression and left frontal cortical asymmetry. While the HC group moved even closer to a balanced left and right frontal state, individuals with BPD toward greater left asymmetry and individuals with MDD moved toward greater right asymmetry. Asymmetry at each time point was also related to self-report of anger for the BPD group. Thus, rejection put individuals with BPD in a more approach-oriented state, linked to an angry mood and aggressive behavior.

Interestingly. groups did not evidence differences in self-report of behavioral activation. However, this may be due to the conceptualization of behavioral activation represented on the Carver and White measure (1994). The measure, developed before the approach nature of anger was demonstrated empirically, does not contain items related to anger, avoiding punishments or active avoidance behaviors. The measure is missing more negative and maladaptive aspects of behavioral activation. The three distinct BAS scales,

reward sensitivity, drive and fun seeking, were moderately correlated with positive affect, but not indices of negative affect in past research, suggesting the scale does not capture the aversive, aroused and negative behavioral activation consistent with BPD (Campbell-Sills et al., 2006). Consistent with this suggestion, Brenner and colleagues (Brenner, Beauchaine, & Sylvers, 2005) found that the BAS scales corresponded with the PANAS, but not physiological markers of motivation measured in incentive contexts. It appears the BAS scales measure affect more than motivation.

Clinical Implications

One clinical implication of the study is that the results may validate the importance of helping foster cognitive abilities such as mentalization, mindfulness and reflective functioning among BPD patients, each a component of a major approach to treating the disorder (Bateman & Fonagy, 2004; Clarkin, Yeomans, & Kernberg, 2006; Linehan, 1993). Though these approaches are distinct in some ways, their commonality rests in that they are different strategies for engaging reflective processes, helping a patient develop greater awareness of her/his own mind and reducing reliance on habitual, automatic, or reflexive processes. Individuals with BPD appear to experience a strong motivational drive to approach following rejection. The antidote for such behavior is not the opposite, withdrawal, but rather cognitive processes that would slow behavioral enactment of emotions and create balance and flexibility within motivational systems. Improvements in representational capacities, effectively moving feelings and urges from behavior to the mind, either through non-judgmental attention (mindfulness) or by an

improved capacity to represent one's own mental states (mentalization/reflective function), may be essential for decreasing enactment of highly maladaptive behaviors like verbal and physical aggression. Mindfulness is likely to decrease approach motivation through an individual's attention to mental events in the present moment, with a curious, open and accepting orientation. The goal of mindfulness is in conflict with the impulse to approach, because mindful attention is a bid to not act on impulses and to accept difficult feelings rather than reacting behaviorally to them. The goals of dynamic theories seem similarly in conflict with approach motivation. The priority in Mentalization Based Therapy (MBT) is helping patients develop reflective capacities for understanding the behavior of onself and others and how these are related to mental states. Such an approach is likely to decrease approach motivation by both promoting the goal of taking a reflective attitude toward one's automatic behavior, in conflict with enactment, and reducing sensitivity to rejection through more accurate appraisals of others' intentions.

Part of what may be important to such approaches to treating BPD may be the promotion of goals that are in conflict with the approach behaviors characteristic of BPD patients. Interestingly, this would be theoretically consistent with work to promote behavioral inhibition system (BIS) functioning, a system active when competing motivations are in play. One possibility is that the more balanced asymmetry evidenced by the HC group is due to such competing goals - the conflict of whether to approach or withdrawal, looking for the possibility of reconnection at the same time as remaining vigilant for cues that defense is a better goal. For individuals with BPD, the goal to avoid rejection and/or maintain connection is much stronger in the moment than other goals, such as social harmony, or even self-protection. Thus, the enhancement of the behavioral

inhibition amongst individuals with the disorder may be healing. Interestingly, the promotion of BIS in individuals with BPD is nicely captured by the theoretical concept of integration, the goal state in Transference Focused Psychotherapy (TFP). In TFP, chaotic emotions and behaviors are thought to stem from splits in representations of self and others. When a BPD patient sees another person in purely negative terms, they are primed for intense affect and maladaptive behavior toward that person. However, integration is thought to calm such affect and behavior by replacing a similar representation with a more nuanced schema, one in which feelings toward others are not singular but nuanced and conflicting. Thus, in an integrated mental state, an individual's anger at another for not calling is in conflict and thus balanced by one's awareness of past responsible and kind behavior. A fascinating follow-up to the present study would evaluate the resolution of left frontal EEG asymmetry in response psychotherapies for the disorder.

In addition, our findings suggest distinct clinical challenges for rejection sensitive patients who respond to rejection with withdrawal. Though the rejection sensitivity literature has focused on the relationship between RS and anger, a subset of individuals may respond to rejection with withdrawal and isolation. Many treatments for MDD emphasize healthy approach oriented behaviors, most prominently behavioral activation, in which patients are encouraged to continue activities that may be rewarding despite strong inclinations to avoid interactions and protect oneself. Approach behaviors may be particularly important among individuals who have a tendency to respond to stress and rejection with withdrawal behaviors, given such behaviors do not allow disconfirmation of negative beliefs about relationships.

Strengths and Limitations

This research was strengthened by a number of factors. We utilized methods that provided a good balance between ecological validity and laboratory control, allowing us to reveal a possible mechanism of aggression in BPD. We also included a comparison patient group, which allowed for comparison to past research and control in terms patient status, negative affect and anxiety, allowing us to demonstrate some specificity of approach motivation in response to rejection in BPD. Our choice to evaluate all participants using diagnostic interviews insured that all groups were well defined, including the healthy control group. Previous research (Bunce et a., 2005) has shown that such comparison groups may routinely include individuals with psychopathology, leaving the "healthy control" group difficult to characterize.

One limitation was our use of both patients with a full diagnosis of MDD and partially remitted patients. However, we found that results were still significant even when excluding the partially remitted patients. Additionally, researchers have found in the past that individuals even with history of MDD show right frontal EEG asymmetry (Vuga et al., 2007). Thus, it seems likely that this aspect of the study did not greatly affect the results.

Another limitation is that our groups were taking distinct classes of medications, with the BPD group taking more medications overall, and more likely to be taking antidepressants, anxiolytic, mood stabilizers and low-dose antipsychotics, all of which could plausibly affect cortical activity. The only class of drugs that was correlated with EEG asymmetry were mood stabilizers, however. One possibility is that this is a spurious

finding, given it was the only significant correlation among 12 tests. Another possibility is that taking mood stabilizers is a proxy for greater emotional lability. It seems unlikely that the action of mood stabilizers is to cause a more leftward cortical asymmetry. Based on previous research, such a shift would be likely to cause more emotional imbalance rather than less (e.g., Harmon-Jones et al., 2002). Rather, it seems more plausible that those with greater mood lability are more likely to be prescribed this medication. It will be important, however, in subsequent research to evaluate the effect of several drug classes on the cortical brain activation of individuals with BPD to evaluate their effect.

Conclusion

Individuals with BPD enact a variety of maladaptive behaviors within the context of interpersonal relationships, behaviors that tend to be both self-destructive and harmful to their connectedness with others. The present research finds support for an increase in approach motivation in response to rejection as a potential mechanism in disturbed interpersonal relationships among individuals with the disorder. Following rejection, BPD patients were more hostile than individuals with depression and showed relatively greater left frontal asymmetry compared to both other groups. The findings open up a variety of questions about the influence of motivation in the disorder, including what other contexts may prompt approach motivation for individuals with BPD and how psychotherapies may be able to ameliorate problematic approach behaviors, such as anger. Psychotherapy work focused on gaining awareness of the impulse to act in angry and maladaptive ways and addressing aversive feelings following rejection experiences may help decrease BPD pathology.

References

Andión, O., Ferrer, M., Gancedo, B., Calvo, N., Barral, C., Torrubia, R., & Casas, M. (2011). Confirmatory factor analysis of borderline personality disorder symptoms based on two different interviews: The structured clinical interview for DSM-IV axis II disorder and the revised diagnostic interview for borderlines. *Psychiatry Research*, *190*(2-3), 304-8. doi:10.1016/j.psychres.2011.05.014

Association, A. P., & American, P. P. A. T. F. O. (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-TR*. American Psychiatric Publishing, Inc. doi:DSM-IV-TR

Ayduk, O., Downey, G., & Kim, M. (2001). Rejection sensitivity and depressive symptoms in women. *Personality and Social Psychology Bulletin*, *27*(7), 868-877. doi:10.1177/0146167201277009

Ayduk, O., Downey, G., Testa, A., Yen, Y., & Shoda, Y. (1999). Does rejection elicit hostility in rejection sensitive women? *Social Cognition*, *17*(2), 245-271.

Ayduk, O., Zayas, V., Downey, G., Cole, A. B., Shoda, Y., & Mischel, W. (2008). Rejection sensitivity and executive control: Joint predictors of borderline personality features. *Journal of Research in Personality*, *42*(1), 151-168. doi:10.1016/j.jrp.2007.04.002

Bateman, A., & Fonagy, P. (2004). *Psychotherapy for borderline personality disorder: Mentalization-based treatment*. Oxford University Press, USA.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497-529.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Manual for the beck depression inventory-ii. Psychological corporation. *San Antonio, TX.*

Berenson, K. R., Downey, G., Rafaeli, E., Coifman, K. G., & Paquin, N. L. (2011). The rejection-rage contingency in borderline personality disorder. *Journal of Abnormal Psychology*, *120*(3), 681-90. doi:10.1037/a0023335

Blackhart, G. C., Nelson, B. C., Knowles, M. L., & Baumeister, R. F. (2009). Rejection elicits emotional reactions but neither causes immediate distress nor lowers self-esteem: A meta-analytic review of 192 studies on social exclusion. *Personality and Social Psychology Review : An Official Journal of the Society for Personality and Social Psychology, Inc*, *13*(4), 269-309. doi:10.1177/1088868309346065

Bouchard, S., & Sabourin, S. (2009). Borderline personality disorder and couple dysfunctions. *Current Psychiatry Reports*, *11*(1), 55-62.

Bouchard, S., Sabourin, S., Lussier, Y., & Villeneuve, E. (2009). Relationship quality and stability in couples when one partner suffers from borderline personality disorder. *J Marital Fam Ther*, *35*(4), 446-55. doi:10.1111/j.1752-0606.2009.00151.x

Brenner, S. L., Beauchaine, T. P., & Sylvers, P. D. (2005). A comparison of psychophysiological and self-report measures of BAS and BIS activation. *Psychophysiology*, *42*(1), 108-15. doi:10.1111/j.1469-8986.2005.00261.x

Brodsky, B. S., Groves, S. A., Oquendo, M. A., Mann, J. J., & Stanley, B. (2006). Interpersonal precipitants and suicide attempts in borderline personality disorder. *Suicide Life Threat Behav*, *36*(3), 313-22. doi:10.1521/suli.2006.36.3.313

Brown, M. Z., Comtois, K. A., & Linehan, M. M. (2002). Reasons for suicide attempts and nonsuicidal self-injury in women with borderline personality disorder. *Journal of Abnormal Psychology*, *111*(1), 198-202. doi:10.1037//0021-843X.111.1.198

Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of Personality and Social Psychology*, *63*(3), 452.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*(2), 319.

Clarkin, J. F., Hull, J. W., & Hurt, S. W. (1993). Factor structure of borderline personality disorder criteria. *Journal of Personality Disorders*, *7*(2), 137-143.

Clarkin, J. F., Yeomans, F. E., & Kernberg, O. F. (2006). *Psychotherapy for borderline personality: Focusing on object relations*. American Psychiatric Pub.

Coan, J. A., & Allen, J. J. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology*, *67*(1-2), 7-49. doi:10.1016/j.biopsycho.2004.03.002

Coan, J. A., & Allen, J. J. B. (2003). Frontal EEG asymmetry and the behavioral activation and inhibition systems. *Psychophysiology*, *40*(1), 106-114.

Coan, J. A., Allen, J. J., & McKnight, P. E. (2006). A capability model of individual differences in frontal EEG asymmetry. *Biological Psychology*, *72*(2), 198-207. doi:10.1016/j.biopsycho.2005.10.003

Critchfield, K. L., Levy, K. N., Clarkin, J. F., & Kernberg, O. F. (2008). The relational context of aggression in borderline personality disorder: Using adult attachment style to predict forms of hostility. *Journal of Clinical Psychology*, *64*(1), 67-82. doi:10.1002/jclp.20434

Davidson, . J. (2003). Alterations in brain and immune function produced by mindfulness meditation. *Psychosomatic Medicine*, *65*(4), 564-570. doi:10.1097/01.PSY.0000077505.67574.E3

Davidson, R. J., Ekman, P., Saron, C. D., Senulis, J. A., & Friesen, W. V. (1990). Approach-withdrawal and cerebral asymmetry: Emotional expression and brain physiology. I. *Journal of Personality and Social Psychology*, *58*(2), 330-41.

Diego, M. A., Field, T., & Hernandez-Reif, M. (2001). BIS/BAS scores are correlated with frontal EEG asymmetry in intrusive and withdrawn depressed mothers. *Infant Mental Health Journal*, *22*(6), 665-675.

Diego, M. A., Field, T., & Hernandez-Reif, M. (2001). CES-D depression scores are correlated with frontal EEG alpha asymmetry. *Depress Anxiety*, *13*(1), 32-7.

Donegan, N. H., Sanislow, C. A., Blumberg, H. P., Fulbright, R. K., Lacadie, C., Skudlarski, P., . . . Wexler, B. E. (2003). Amygdala hyperreactivity in borderline personality disorder: Implications for emotional dysregulation. *Biological Psychiatry*, *54*(11), 1284-93.

Downey, G., & Feldman, S. I. (1996). Implications of rejection sensitivity for intimate relationships. *Journal of Personality and Social Psychology*, *70*(6), 1327-43.

Downey, G., Freitas, A. L., Michaelis, B., & Khouri, H. (1998). The self-fulfilling prophecy in close relationships: Rejection sensitivity and rejection by romantic partners. *Journal of Personality and Social Psychology*, *75*(2), 545-60.

Dyck, M., Habel, U., Slodczyk, J., Schlummer, J., Backes, V., Schneider, F., & Reske, M. (2009). Negative bias in fast emotion discrimination in borderline personality disorder. *Psychological Medicine*, *39*(5), 855-64. doi:10.1017/S0033291708004273

Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An FMRI study of social exclusion. *Science (New York, N.Y.)*, *302*(5643), 290-2. doi:10.1126/science.1089134

Evren, C., Cinar, O., Evren, B., & Celik, S. (2011). History of suicide attempt in male substance-dependent inpatients and relationship to borderline personality features, anger, hostility and aggression. *Psychiatry Research*, *190*(1), 126-31. doi:10.1016/j.psychres.2011.08.002

Feldman, S., & Downey, G. (1994). Rejection sensitivity as a mediator of the impact of childhood exposure to family violence on adult attachment behavior. *Development and Psychopathology*, *6*(1), 231-247.

First, M. B., Spitzer, R. L., & Williams, J. B. (1997). *Structured clinical interview for DSM-IV axis I disorders SCID-I: Clinician version, administration booklet*. American Psychiatric Pub.

Fowles, D. C. (1980). The three arousal model: Implications of gray' s two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology*, *17*(2), 87-104.

Franken, I. H. A. (2002). Behavioral approach system (BAS) sensitivity predicts alcohol craving. *Personality and Individual Differences*, *32*(2), 349-355.

Gardner, K. J., Qualter, P., Stylianou, M., & Robinson, A. J. (2010). Facial affect recognition in non-clinical adults with borderline personality features: The role of effortful control and rejection sensitivity. *Personality and Individual Differences*, *49*(7), 799-804. doi:10.1016/j.paid.2010.07.018

Gotlib, I. H. (1998). EEG alpha asymmetry, depression, and cognitive functioning. *Cognition & Emotion*, *12*(3), 449-478.

Gray, J. A. (1970). The psychophysiological basis of introversion-extraversion. *Behaviour Research and Therapy*, *8*(3), 249-266.

Gray, J. A. (1978). The neuropsychology of anxiety. *Br J Psychol*, *69*(4), 417-34.

Gray, J. A. (1987). The neuropsychology of emotion and personality.

Gray, J. A. (1990). Brain systems that mediate both emotion and cognition. *Cognition & Emotion*, *4*(3), 269-288.

Gunderson, J. G. (2007). Disturbed relationships as a phenotype for borderline personality disorder. *The American Journal of Psychiatry*, *164*(11), 1637-40. doi:10.1176/appi.ajp.2007.07071125

Harmon-Jones, C., Schmeichel, B. J., Mennitt, E., & Harmon-Jones, E. (2011). The expression of determination: Similarities between anger and approach-related

positive affect. *Journal of Personality and Social Psychology*, *100*(1), 172-81. doi:10.1037/a0020966

Harmon-Jones, E. (2003a). Anger and the behavioral approach system. *Personality and Individual Differences*, *35*(5), 995-1005.

Harmon-Jones, E. (2003b). Anger and the behavioral approach system. *Personality and Individual Differences*, *35*(5), 995-1005.

Harmon-Jones, E. (2007). Trait anger predicts relative left frontal cortical activation to anger-inducing stimuli. *International Journal of Psychophysiology : Official Journal of the International Organization of Psychophysiology*, *66*(2), 154-60. doi:10.1016/j.ijpsycho.2007.03.020

Harmon-Jones, E., & Allen, J. J. (1997). Behavioral activation sensitivity and resting frontal EEG asymmetry: Covariation of putative indicators related to risk for mood disorders. *Journal of Abnormal Psychology*, *106*(1), 159-63.

Harmon-Jones, E., & Sigelman, J. (2001). State anger and prefrontal brain activity: Evidence that insult-related relative left-prefrontal activation is associated with experienced anger and aggression. *Journal of Personality and Social Psychology*, *80*(5), 797-803.

Henriques, J. B., & Davidson, R. J. (1990). Regional brain electrical asymmetries discriminate between previously depressed and healthy control subjects. *Journal of Abnormal Psychology*, *99*(1), 22-31.

Hewig, J., Hagemann, D., Seifert, J., Naumann, E., & Bartussek, D. (2006). The relation of cortical activity and BIS/BAS on the trait level. *Biological Psychology*, *71*(1), 42-53. doi:10.1016/j.biopsycho.2005.01.006

Hill, J., Pilkonis, P., Morse, J., Feske, U., Reynolds, S., Hope, H., . . . Broyden, N. (2008). Social domain dysfunction and disorganization in borderline personality disorder. *Psychological Medicine*, *38*(1), 135-46. doi:10.1017/S0033291707001626

Hillman, J. L., Stricker, G., & Zweig, R. A. (1997). Clinical psychologists' judgments of older adult patients with character pathology: Implications for practice. *Professional Psychology: Research and Practice*, *28*(2), 179.

Kambouropoulos, N., & Staiger, P. K. (2001). The influence of sensitivity to reward on reactivity to alcohol-related cues. *Addiction (Abingdon, England)*, *96*(8), 1175-85. doi:10.1080/09652140120060761

Kelly, T. M., Soloff, P. H., Lynch, K. G., Haas, G. L., & Mann, J. J. (2000). Recent life events, social adjustment, and suicide attempts in patients with major depression and borderline personality disorder. *Journal of Personality Disorders*, *14*(4), 316-26.

Klonsky, E. D., Oltmanns, T. F., & Turkheimer, E. (2003). Deliberate self-harm in a nonclinical population: Prevalence and psychological correlates. *The American Journal of Psychiatry*, *160*(8), 1501-8.

Knoch, D., Gianotti, L. R., Pascual-Leone, A., Treyer, V., Regard, M., Hohmann, M., & Brugger, P. (2006). Disruption of right prefrontal cortex by low-frequency repetitive transcranial magnetic stimulation induces risk-taking behavior. *The Journal of Neuroscience : The Official Journal of the Society for Neuroscience*, *26*(24), 6469-72. doi:10.1523/JNEUROSCI.0804-06.2006

Koslov, K., Mendes, W. B., Pajtas, P. E., & Pizzagalli, D. A. (2011). Asymmetry in resting intracortical activity as a buffer to social threat. *Psychological Science*, *22*(5), 641-9. doi:10.1177/0956797611403156

Kruedelbach, N., McCormick, R. A., Schulz, S. C., & Grueneich, R. (1993). Impulsivity, coping styles, and triggers for craving in substance abusers with borderline personality disorder. *Journal of Personality Disorders*, *7*(3), 214-222.

Lawrence, K. A., Chanen, A. M., & Allen, J. S. (2011). The effect of ostracism upon mood in youth with borderline personality disorder. *Journal of Personality Disorders*, *25*(5), 702-14. doi:10.1521/pedi.2011.25.5.702

Limberg, A., Barnow, S., Freyberger, H. J., & Hamm, A. O. (2011). Emotional vulnerability in borderline personality disorder is cue specific and modulated by traumatization. *Biological Psychiatry*, *69*(6), 574-82. doi:10.1016/j.biopsych.2010.10.024

Linehan, M. (1993). *Cognitive-behavioral treatment of borderline personality disorder*. The Guilford Press.

Linehan, M. (1995). *Understanding borderline personality disorder*. Guilford Publications.

Loranger, A. W., Janca, A., & Sartorius, N. (1997). *Assessment and diagnosis of personality disorders: The ICD-10 international personality disorder examination (IPDE)*. Cambridge Univ Pr.

McFarland, B. R., Shankman, S. A., Tenke, C. E., Bruder, G. E., & Klein, D. N. (2006). Behavioral activation system deficits predict the six-month course of depression. *Journal of Affective Disorders*, *91*(2-3), 229-34. doi:10.1016/j.jad.2006.01.012

McGirr, A., Paris, J., Lesage, A., Renaud, J., & Turecki, G. (2007). Risk factors for suicide completion in borderline personality disorder: A case-control study of cluster B comorbidity and impulsive aggression. *J Clin Psychiatry*, *68*(5), 721-9.

McNaughton, N., & Corr, P. J. (2004). A two-dimensional neuropsychology of defense: Fear/anxiety and defensive distance. *Neurosci Biobehav Rev*, *28*(3), 285-305. doi:10.1016/j.neubiorev.2004.03.005

Meyer, B., Ajchenbrenner, M., & Bowles, D. P. (2005). Sensory sensitivity, attachment experiences, and rejection responses among adults with borderline and avoidant features. *Journal of Personality Disorders*, *19*(6), 641-58. doi:10.1521/pedi.2005.19.6.641

Modestin, J. (1987). Quality of interpersonal relationships: The most characteristic DSM-III BPD criterion. *Compr Psychiatry*, *28*(5), 397-402.

Morse, J. Q., Hill, J., Pilkonis, P. A., Yaggi, K., Broyden, N., Stepp, S., . . . Feske, U. (2009). Anger, preoccupied attachment, and domain disorganization in borderline personality disorder. *Journal of Personality Disorders*, *23*(3), 240-57. doi:10.1521/pedi.2009.23.3.240

Nezlek, . B., Kowalski, . M., Leary, . R., Blevins, T., & Holgate, S. (1997). Personality moderators of reactions to interpersonal rejection: Depression and trait self-esteem. *Personality and Social Psychology Bulletin*, *23*(12), 1235-1244. doi:10.1177/01461672972312001

Ogata, S. N., Silk, K. R., Goodrich, S., Lohr, N. E., Westen, D., & Hill, E. M. (1990). Childhood sexual and physical abuse in adult patients with borderline personality disorder. *American Journal of Psychiatry*, *147*(8), 1008-1013.

Peterson, C. K., Gravens, L. C., & Harmon-Jones, E. (2011). Asymmetric frontal cortical activity and negative affective responses to ostracism. *Social Cognitive and Affective Neuroscience*, *6*(3), 277-85. doi:10.1093/scan/nsq027

Peterson, C. K., Shackman, A. J., & Harmon-Jones, E. (2008). The role of asymmetrical frontal cortical activity in aggression. *Psychophysiology*, *45*(1), 86-92. doi:10.1111/j.1469-8986.2007.00597.x

Ray, W. J., & Cole, H. W. (1985). EEG alpha activity reflects attentional demands, and beta activity reflects emotional and cognitive processes. *Science (New York, N.Y.)*, *228*(4700), 750-752. Retrieved from http://www.jstor.org/stable/1694556

Russell, J. J., Moskowitz, D. S., Zuroff, D. C., Sookman, D., & Paris, J. (2007). Stability and variability of affective experience and interpersonal behavior in borderline personality disorder. *Journal of Abnormal Psychology*, *116*(3), 578-88. doi:10.1037/0021-843X.116.3.578

Sanislow, C. A., Grilo, C. M., & McGlashan, T. H. (2000). Factor analysis of the DSM-III-R borderline personality disorder criteria in psychiatric inpatients. *The American Journal of Psychiatry*, *157*(10), 1629-33.

Schienle, A., Schäfer, A., Hermann, A., & Vaitl, D. (2009). Binge-eating disorder: Reward sensitivity and brain activation to images of food. *Biological Psychiatry*, *65*(8), 654-61. doi:10.1016/j.biopsych.2008.09.028

Scott, L. N., Levy, K. N., Adams, R. B., & Stevenson, M. T. (2011). Mental state decoding abilities in young adults with borderline personality disorder traits. *Personal Disord*, *2*(2), 98-112. doi:10.1037/a0020011

Selby, E. A., Ward, A. C., & Joiner, T. E. (2010). Dysregulated eating behaviors in borderline personality disorder: Are rejection sensitivity and emotion dysregulation linking mechanisms? *Int J Eat Disord*, *43*(7), 667-70. doi:10.1002/eat.20761

Slavich, G. M., Thornton, T., Torres, L. D., Monroe, S. M., & Gotlib, I. H. (2009). TARGETED REJECTION PREDICTS HASTENED ONSET OF MAJOR DEPRESSION. *Journal of Social and Clinical Psychology*, *28*(2), 223-243. doi:10.1521/jscp.2009.28.2.223

Staebler, K., Helbing, E., Rosenbach, C., & Renneberg, B. (2011). Rejection sensitivity and borderline personality disorder. *Clin Psychol Psychother*, *18*(4), 275-83. doi:10.1002/cpp.705

Staebler, K., Renneberg, B., Stopsack, M., Fiedler, P., Weiler, M., & Roepke, S. (2011). Facial emotional expression in reaction to social exclusion in borderline personality disorder. *Psychological Medicine*, *41*(9), 1929-38. doi:10.1017/S0033291711000080

Stepp, S. D., Pilkonis, P. A., Yaggi, K. E., Morse, J. Q., & Feske, U. (2009). Interpersonal and emotional experiences of social interactions in borderline personality disorder. *The Journal of Nervous and Mental Disease*, *197*(7), 484-91. doi:10.1097/NMD.0b013e3181aad2e7

Stewart, J. L., Bismark, A. W., Towers, D. N., Coan, J. A., & Allen, J. J. (2010). Resting frontal EEG asymmetry as an endophenotype for depression risk: Sex-specific patterns of frontal brain asymmetry. *Journal of Abnormal Psychology*, *119*(3), 502-12. doi:10.1037/a0019196

Stiglmayr, C. E., Grathwol, T., Linehan, M. M., Ihorst, G., Fahrenberg, J., & Bohus, M. (2005). Aversive tension in patients with borderline personality disorder: A computer-based controlled field study. *Acta Psychiatr Scand*, *111*(5), 372-9. doi:10.1111/j.1600-0447.2004.00466.x

Sutton, S. K., & Davidson, R. J. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioral approach and inhibition systems. *Psychological Science*, *8*(3), 204-210. Retrieved from http://www.jstor.org/stable/40063179

Tomarken, A. J., Davidson, R. J., Wheeler, R. E., & Doss, R. C. (1992). Individual differences in anterior brain asymmetry and fundamental dimensions of emotion. *Journal of Personality and Social Psychology*, *62*(4), 676-87.

Verona, E., Sadeh, N., & Curtin, J. J. (2009). Stress-induced asymmetric frontal brain activity and aggression risk. *Journal of Abnormal Psychology*, *118*(1), 131-45. doi:10.1037/a0014376

Vuga, M., Fox, N. A., Cohn, J. F., George, C. J., Levenstein, R. M., & Kovacs, M. (2006). Long-term stability of frontal electroencephalographic asymmetry in adults with a history of depression and controls. *International Journal of Psychophysiology : Official Journal of the International Organization of Psychophysiology*, *59*(2), 107-15. doi:10.1016/j.ijpsycho.2005.02.008

Watson, D., & Clark, L. A. (1999). The PANAS-X: Manual for the positive and negative affect schedule-expanded form.

Widiger, T. A., & Trull, T. J. (1993). Borderline and narcissistic personality disorders.

Williams, K. D., Cheung, C. K., & Choi, W. (2000). Cyberostracism: Effects of being ignored over the internet. *Journal of Personality and Social Psychology*, *79*(5), 748-62.

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PUBLICATIONS

Refereed Articles

1. Aberson, C.A. & **Beeney**, J.E. (2007). Does substance use impact implicit association test reliabilities? *Journal of Social Psychology, 147*, 27-40.
2. **Beeney**, J.E. & Arnett, P.A. (2008). Stress and memory bias interact to predict depression in multiple sclerosis. *Neuropsychology*, *22*(1) 118-126.
3. Arnett, P.A., Barwick, F.H., & **Beeney**, J.E. (2008). Depression in Multiple Sclerosis: Review and Theoretical Proposal. *Journal of the International Neuropsychological Society*.
4. **Beeney**, J.E. & Arnett, P.A. (2008). Endorsement of self-report neurovegetative items of depression is associated with multiple sclerosis disease symptoms. *Journal of the International Neuropsychological Society*.
5. Levy, K.N., **Beeney**, J.E., Wasserman, R.H., & Clarkin, J.F. (2010). Conflict begets conflict: executive attention, mental state vacillations and the therapeutic alliance in Borderline Personality Disorder. *Psychotherapy Research*. *20*(10), 413-422.
6. Levy, K.N., **Beeney**, J.E., & Temes, C.M. (2011). Attachment and its vicissitudes in Borderline Personality Disorder. *Current Psychiatry Reports*, *13*, 50-59.
7. **Beeney,** J.E., Franklin, R., Levy, K.N., & Adams, R.B. (2011). I feel your pain: Neural responses to vicarious rejection. *Social Neuroscience*. *6*(4), 369-376.
8. Franklin, R.G., Jr., Nelson, A. J., Baker, M., **Beeney**, J. E., Lenz-Watson, A., Vescio, T. K., & Adams, R. B. Jr. (2013). Neural mechanisms of empathy for humans and animals. *Social Neuroscience.*