EMOTION REGULATION IN BORDERLINE PERSONALITY DISORDER: AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF ACCEPTANCE AND SUPPRESSION

by

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Abstract

The primary aim of this research was to examine the effects of different emotion regulation strategies on emotions, psychophysiology, and behavioural urges among persons with BPD. Findings from several studies suggest that persons with borderline personality disorder (BPD) demonstrate heightened emotional vulnerability and a tendency to regulate emotions with potentially maladaptive avoidance strategies. Despite accumulating research on emotional responding in BPD, there is a dearth of research on the direct effects of different emotion regulation strategies in this population. For this research, participants with BPD, major depressive disorder, or non-psychiatric controls ($N = 100$) were randomly assigned to listen to a rationale for either emotional acceptance or emotional suppression. Subsequently, participants listened to an audio-recording of a social rejection scenario. Subjective distress, heart rate, skin conductance, respiratory sinus arrhythmia, and facial electromyography were assessed before, during, and after the emotion induction. Afterwards, participants completed a behavioural measure of distress tolerance. Participants in the acceptance condition reported more negative emotions than those in the suppression condition, particularly among BPD participants. The BPD group also reported higher urges to engage in maladaptive behaviours in the acceptance condition. The BPD participants exhibited a distinctive pattern of physiological responses, with more positively valenced facial expressions and lower skin conductance compared with the control group, despite their reported distress. These results suggest that individuals with BPD may struggle in the short-term with the use of acceptance-based regulation strategies in response to acute stressors, compared with non-psychiatric controls and other clinical groups.

Keywords: Borderline personality disorder; Emotion regulation

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BPD is a serious health concern that heavily taxes the mental health system (Widiger & Frances, 1989). The disorder is characterized by intense emotional experiences, conflict in interpersonal relationships, sensitivity to cues of abandonment, suicidality, non-suicidal self-injury, and impulsive, self-destructive behaviours (American Psychiatric Association, 2000). Although the prevalence of BPD in the general population ranges from 2% (Swart, Blazer, George, & Winfield, 1990) to 6% (Grant et al., 2008), these individuals constitute a substantial proportion of psychiatric inpatients (40-44%, Grilo et al., 1998; Marinangeli, et al., 2000) and outpatients (22.6%; Korzekwa, Dell, Links, Thabane, & Webb, 2008). Findings suggest the cost to treat BPD in the community is in excess of $17,000 US dollars per patient per year (Linehan, Armstrong, Suarez, Allmon, & Heard, 1991). This high degree of treatment utilization is likely attributable to the high prevalence of non-suicidal self-injury (Shearer, 1994; Shearer, Peters, Quaytman, & Ogden, 1990; Soloff, Lis, Kelly, Cornelius, & Ulrich, 1994) and suicide attempts (Paris & Zweig-Frank, 2001) among persons with BPD. As many as 75% of all BPD patients have a history of at least one self-injurious act (Clarkin, Widiger, Frances, Hurt, & Gilmore, 1983; Cowdry, Pickar, & Davies, 1985) and suicide rates among this group are estimated at approximately 10% (Frances, Fyer, & Clarkin, 1986; Paris, Brown, & Nowlis, 1987). These self-destructive behaviours are often conceptualized as attempts to regulate, escape, distract, or attenuate unwanted emotional experiences (Chapman, Dixon-Gordon, & Walters, 2011; Linehan, 1993).

Emotion Dysregulation and BPD

According to Linehan (1993), BPD is characterized by emotion vulnerability and emotion dysregulation. Emotion vulnerability refers to the (presumably biological) vulnerability towards intense, low-threshold, and long-lasting emotional responses. Emotion dysregulation consists of difficulties monitoring, accepting, or modulating emotional experiences, and the inability to engage in goal-directed behaviour in the context of emotional distress (Gratz & Roemer, 2004). Thus, individuals with BPD struggle with frequent, intense negative emotions and lack strategies to modulate or tolerate these emotions. Many of the behavioural difficulties of persons with BPD are theorized to occur in response to emotional stressors and may function to regulate or reduce emotional arousal (e.g. non-suicidal self-injury; Chapman & Dixon-Gordon, 2007; Chapman, Gratz & Brown, 2006).

Extant research on emotional vulnerability in BPD has shown some consistent patterns (c.f. Rosenthal et al., 2008). Generally, persons with BPD report higher intensity (Levine, Marziali, & Hood, 1997) and frequency (Stiglmayr et al., 2005) of negative emotions compared with non-BPD controls. The physiological evidence for biological underpinnings of emotional vulnerability in BPD, however, is inconclusive. Some findings suggest the presence of functional and anatomical brain abnormalities among persons with BPD related to emotional functioning (Donegan et al., 2003; Herpertz et al., 2001; Juengling et al., 2003; Minzenberg, Fan, New, Tang, & Siever, 2007; Silbersweig et al., 2007). In terms of sympathetic arousal, some studies indicate that persons with

BPD exhibit lower reactivity, compared with participants with avoidant personality disorder (Herpertz et al., 2000) and controls (Herpertz, Kunert, Schwenger, & Sass, 1999). In another study, however, findings suggested sympathetic hyperarousal in BPD when controlling for the effects of dissociation (Ebner-Priemer et al., 2005). Further, findings from studies assessing parasympathetic activity have indicated that individuals with BPD have lower parasympathetic activity in comparison with control participants, particularly during emotional stressors (e.g., Austin, Riniolo, & Porges, 2007; Kuo & Linehan, 2009). Similar incongruities between self-reported emotional experience and autonomic arousal have been found among individuals with deficits in emotion identification (i.e., alexithymia; Connelly & Denney, 2007).

Mounting evidence suggests that individuals with BPD may demonstrate heightened self-reported and psychophysiological emotional reactivity in response to interpersonal stressors in particular. In one study, nearly half of the events found to precede emotional distress among BPD participants involved rejection or abandonment (Stiglmayr et al., 2005). In a laboratory study (Schmahl, Vermetten, Elzinga, & Bremner, 2004), individuals with BPD exhibited (non-significantly) larger skin conductance responses in response to abandonment and abuse scripts, compared with participants with post-traumatic stress disorder and control participants. Another experimental study demonstrated that participants with high levels of BPD features showed heightened anger reactivity (relative to controls) to a social rejection stressor, but not to an academic failure stressor (Chapman, Walters, & Dixon-Gordon, 2011a) or a frustrating task (Chapman et al. 2011b). In response to a social rejection task in the laboratory, patients with BPD demonstrated fewer positive and more "mixed" facial expressions (i.e., more than one at a time), compared with non-psychiatric controls (Staebler et al., 2011). Collectively, these findings indicate that individuals with BPD may exhibit greater emotional vulnerability in response to specific stimuli, such as social rejection.

There is some evidence of reactivity in specific emotional domains among persons with BPD, as well. Extant research suggests that people with BPD may be more likely to experience emotional reactivity with regard to sadness, fear, anger, and shame-related emotions. For instance, participants with BPD were more likely to experience larger fluctuations in sadness, fear, and hostility, in their daily lives, compared with depressed participants, using ecological momentary assessment (Trull et al., 2008). In particular, participants reported more changes in terms of feelings of hostility. In addition, individuals with BPD may be particularly prone to fearful responses. In a study examining identification of emotional facial expressions, participants with BPD demonstrated greater accuracy in their identification of fearful expressions, compared with participants with and without histories of childhood sexual abuse and no BPD (Wagner & Linehan, 1999). Participants with high levels of BPD features also demonstrate greater impulsivity following a fear induction, compared with a neutral induction, although this was not the case for participants with low levels of BPD features (Chapman et al., 2011a). Findings from one study (Gratz, Rosenthal, Tull, Lejuez, & Gunderson, 2010) suggest that persons with BPD may be predisposed to experience increased shame, but not other emotions, in reaction to negative evaluative feedback. Consistent with this research, females with BPD reported higher levels of trait shame proneness, and state shame, compared with participants with social phobia and non-psychiatric controls (Rüsch et al., 2007). Therefore, there is some evidence for the possibility of heightened shame and anger proneness in BPD,

Individuals with BPD demonstrate emotion dysregulation across several domains. Existing research, largely based on self-report measures, indicates that BPD features are linked to difficulties regulating emotions (Chapman, Leung, & Lynch, 2008). Features of BPD are also associated with lower emotional awareness (Leible & Snell, 2004) and greater fear of emotions (Yen, Zlotnick, & Costello, 2002). An inability to differentiate specific emotions has been hypothesized to contribute to difficulties with emotion regulation (Linehan, 1993). Emotional responses are often viewed as functional responses to stressors, which can serve as motivators to solve problems or solicit assistance from others via emotional expression. In the absence of correct emotion identification, such problem solving and effective emotional expression may be negatively impacted. Consistent with this view, findings from cross-sectional (Levine et al., 1997; Modestin, Furrer, & Malti, 2004; Zlotnick, Mattia, & Zimmerman, 2001) and ecological momentary assessment studies (Wolff, Stiglmayr, Bretz, Lammers, & Auckenthaler, 2007) suggest that BPD symptoms are associated with deficits in emotional identification and communication. Instead of identifying distinct emotions, individuals with BPD tend to endorse broad, non-specific emotions (e.g., “aversive inner tension”, Stiglmayr et al., 2001). Data from brain imaging studies suggest that labelling emotions, versus matching emotional facial expressions, results in decreased emotional arousal in response to emotional stimuli (Lieberman et al., 2007). Specifically, using functional magnetic resonance imaging, labelling emotions led to greater activity in the right ventrolateral prefrontal cortex, a region associated with emotional control. There was an inverse relationship between activation of the ventrolateral prefrontal cortex and activity in the amygdala, associated with emotional arousal, suggesting that the act of labelling emotions leads to a reduction in distress. Importantly, research suggests that an inability to label emotions is more strongly linked with distress among persons with BPD in their daily lives than among other groups (Ebner-Priemer et al., 2008).

At present, only a few laboratory studies have directly examined emotion regulation in BPD. In one of the first studies in this area, participants with BPD were more likely to quit a frustrating task, even when persistence on this task was rewarded with an opportunity to later earn money, compared with non-BPD participants (Gratz, Rosenthal, Tull, Lejuez, & Gunderson, 2006). In another study, substance users with BPD terminated a frustrating, computerized mirror tracing task sooner than substance users without BPD (Bornovalova et al., 2008). These findings suggest that individuals with BPD have particular difficulty with one aspect of emotion regulation – the ability to persist in goal-directed behaviour despite emotional distress (Gratz & Roemer, 2004). Consistent with these findings, individuals with BPD may also have a lower capacity to withstand negative emotions, or low distress tolerance (e.g., Bornovalova et al., 2008).

This combination of intense negative emotions, low distress tolerance, and a narrow repertoire of effective emotion regulation strategies may lead people with BPD to suppress or avoid experiencing their emotions. Indeed, individuals with BPD are more likely to use avoidant strategies to regulate emotions (Bijttebier & Vertommen, 1999), involving emotional avoidance or suppression. Findings from our laboratory have indicated that the severity and diagnosis of BPD are associated with greater levels of emotional avoidance and suppression (Chapman, Specht, & Cellucci, 2005). Other findings have indicated that such emotional avoidance mediates the association of negative emotionality with BPD (Rosenthal, Cheavens, Lejuez, & Lynch, 2005). Taken together, existing research and theory underscores the role of experiential avoidance in maintaining symptomatology in BPD (c.f., Chapman et al., 2011b).

Emotional Avoidance and Suppression

Studies have examined several forms of suppression and avoidant emotion regulation strategies. Much research has focused on the effects of expressive suppression, or the direct inhibition of emotional facial expressions (Gross, 1998; Gross & John, 2003). Expressive suppression has been theorized to reduce the expression of emotion, as well as the immediate subjective experience of emotion, but leads to an increase in physiological arousal over the long-term (c.f. Gross & Thompson, 2007). Other researchers have focused on the role of suppression of unwanted thoughts in relation to psychopathology (e.g., Wegner & Erber, 1992). Findings suggest that suppressing thoughts paradoxically leads to a subsequent increase in the frequency of the unwanted thoughts, termed a “rebound effect” (Wegner, 1994), particularly when people are under stress or engaging in a concurrent task that requires effort (Abramowitz, Tolin, & Street, 2001; Wegner & Erber, 1992). The rebound effect has been demonstrated with regard to mood and mood-related thoughts as well (Wegner, Broome, & Blumfield, 1997; Wegner, Erber, & Zanakos; 1993). A broader construct than emotion suppression, emotional avoidance encompasses suppression of any unwanted emotional experiences, including thoughts, emotions, and body sensations (Hayes et al., 1999). For the present study, the term “emotion suppression” is used with an emphasis on the avoidance of the subjective experience of emotions, more in line with Hayes’ conceptualization of avoidance.

Emotion suppression, defined as the direct inhibition of the expression (Gross & John, 2003) and/or experience of emotions (Feldner, Zvolensky, Eifert, & Spira, 2003), has been associated with negative outcomes in several studies. Although emotion suppression may result in lower levels of reported positive emotions, it sometimes does not affect the level of reported negative emotions (e.g., Gross & Levenson, 1997; Stepper & Strack, 1993; Strack, Martin, & Stepper, 1988). Emotion suppression may, however, be linked with a qualitative change in the experience of emotions. For instance, emotion suppression was correlated with alexithymia (Kirmayer & Robbins, 1993), suggesting that emotion suppression may impede people's ability to distinguish between specific emotions. In the laboratory, individuals who tended to avoid emotional experiences were less accurate in emotion recognition, particularly with regard to the identification of anger, sadness, fear, and happiness (Lane, Sechrest, Riedel, Shapiro, & Kaszniak, 2000). Emotion suppression can also lead to a subsequent increase in the avoided experiences. For instance, individuals who engaged in emotion suppression while viewing disgust-related visual stimuli reported an increase in intrusive thoughts following a laboratory task (Lynch, Schneider, Rosenthal, & Cheavens, 2007). Individuals with a chronic tendency to avoid negative emotions may, paradoxically, be more likely to experience distress in response to emotion suppression (Levitt, Brown, Orsillo, & Barlow, 2004). Indeed, the tendency to experience high negative affect was associated with less effective suppression in the laboratory, such that participants who experienced chronic negative affect reported substantially more negative emotionality when asked to suppress (Dalgleish, Yiend, Schweizer, & Dunn, 2009).

In the laboratory, expressive suppression appears to increase sympathetic nervous system activity (Gross & Levenson, 1997), and possibly affects parasympathetic nervous system activity among non-psychiatric participants (Butler, Wilhelm, & Gross, 2006). Further, mood-disordered and anxious participants exhibit similar patterns of physiological arousal when instructed to suppress emotions in the laboratory (Campbell-Sills, Barlow, Brown, & Hofman, 2006; Levitt et al., 2004).

The use of suppression also impairs performance on subsequent tasks. For instance, suppression has been associated with social costs. Participants who were instructed to inhibit emotional expression during a conversation with a partner experienced increased levels of parasympathetic indicators as well as sympathetic arousal (Butler et al., 2006). Moreover, the conversation partner was less likely to choose to interact with an individual again if that individual had been inhibiting his or her emotional expression during the conversation. Individuals instructed to suppress emotions (Dunn, Billoti, Murphy, & Dalgleish, 2009) and inhibit emotional expressions (Richards & Gross, 2000) also suffer from impairment in their ability to recall memories.

Of particular importance, literature suggests that self-regulation is a finite resource, and that suppression may deplete this resource. Although suppression may effectively reduce the subjective experience of negative emotions in the moment, the effort involved in the suppression of emotions can result in depleted resources for impulse control or coping with subsequent stressors (Muraven, Tice, & Baumeister, 1997). Specifically, these studies suggested that regulation of emotions in response to a distressing film led to less physical stamina in subsequent tasks. Further, thought suppression resulted in giving up earlier on solving difficult anagrams. Similarly, findings suggest that emotion suppression has a detrimental effect on social interactions and memory recall. Thus, suppression is likely to set the stage for difficulty managing emotions in subsequent tasks, thereby decreasing distress tolerance.

Findings suggest that these negative consequences of emotion suppression also occur among individuals who suffer from BPD (c.f. Chapman et al., 2011b). For a population that struggles with low distress tolerance (Gratz et al., 2006), resulting in many maladaptive coping efforts, any depletion of self-regulatory resources associated with suppression would be particularly problematic. For instance, Chapman and colleagues (2005) found that BPD symptoms were associated with emotional avoidance, and that thought suppression was associated with self-injurious behaviours among persons with BPD. Research also indicates that emotion suppression accounted for the association between sexual trauma and psychiatric symptoms (Polusny, Rosenthal, Aban, & Follette, 2004; Rosenthal et al., 2005). The tendency to avoid emotional experiences mediated the relationship between negative affect reactivity and intensity and BPD features, even after controlling for child abuse (Rosenthal et al., 2005). In another study, thought suppression mediated the relationship between negative affect reactivity and intensity and BPD features (Cheavens et al., 2005). A recent study examined reactivity of the right lateral prefrontal region in response to suppression of sadness, and found that activation of this region was negatively correlated with self-reported success with suppression among BPD participants, but this was not the case for controls (Ruocco, Medaglia, Ayaz, & Chute, 2010). This body of research suggests that emotional suppression as a strategy for managing emotions may have negative effects for people with and without BPD.

In contrast, emerging research suggests that emotion suppression may be an adaptive emotion regulation strategy in some contexts. In one study, participants high and low in BPD features were instructed to observe or suppress their emotions in their everyday lives, and reported their emotions and urges throughout the day using a handheld computer (Chapman, Rosenthal, & Leung, 2009). The high-BPD participants who were instructed to suppress their emotions reported fewer urges to engage in maladaptive behaviours and higher ratings of positive emotions, in comparison with those individuals who were instructed to simply observe their emotions. In addition, another study demonstrated that participants who engaged in emotion suppression, instead of emotional acceptance, exhibited less physiological reactivity in response to a distressing film (Dunn et al., 2009). Further, the individuals who had suppressed their emotions reported recalling fewer distressing details from the film. The suppression group also reported lower levels of subjective distress, even one week following the experiment, in comparison with the acceptance condition. These findings suggest that suppression may be advantageous under certain conditions.

To date, I am only aware of three published studies that have examined the effect of instructed suppression in BPD. As described above, one study found that right lateral prefrontal activation was associated with difficulty suppressing sadness among BPD participants, but this was not the case for non-psychiatric controls (Ruocco et al., 2010). However, a study of electrophysiological responsivity to standardized emotional stimuli (International Affective Picture System, IAPS; Lang, Bradley, & Cuthbert, 2008) suggested that, participants with BPD exhibited larger late positive potentials to unpleasant images compared with control participants, suggesting a more exaggerated emotional response (Marissen, Meuleman, & Franken, 2010). Yet there were no differences between groups in terms of reactivity to suppression instructions. Although illuminating, neither of these studies utilized ecologically valid behavioural measures, nor did they include psychiatric control groups. As noted previously, one study (Chapman, et al., 2009) using ecological momentary assessment methods, undergraduates high or low in features of BPD were instructed to engage in either emotion suppression or observation. The results indicated that emotion suppression was associated with more positive emotions and lower urges to engage in maladaptive behaviours among the high-BPD group. This study did not evaluate the real-time effects of emotion suppression on subsequent task performance, however, and did not assess the physiological consequences of suppression. These inconclusive results underscore the need for further examination of the effects of suppression the laboratory among persons with BPD.

Emotional Acceptance vs. Avoidance

Dialectical Behaviour Therapy (DBT; Linehan, 1993) has the most empirical support as a treatment for BPD. In DBT, therapists encourage patients to stop avoiding or suppressing their emotions (Linehan 1993). As an alternative emotion regulation strategy, patients are taught to mindfully accept (i.e., allowing the emotion to occur and simply noticing the emotion come and go) their negative emotions, in addition to other strategies to modulate emotional distress. The rationale for these interventions is that emotional acceptance may decrease the tendency to avoid aversive internal experiences through impulsive behaviours (e.g., non-suicidal self-injury, suicidal behaviour, drug use). Indeed, acceptance-based approaches to negative emotions are associated with positive outcomes in several domains. For example, among anxious or depressed individuals, brief acceptance-based interventions are associated with lower physiological arousal (e.g., Campbell-Sills et al., 2006; Levitt et al., 2004). Mindfulness training is associated with greater parasympathetic activity, and decreased sympathetic activity (Delgado et al., 2010). Acceptance-based treatments have demonstrated efficacy for a variety of clinical problems, including anxiety, depression, psychotic symptoms, and substance-dependence (e.g., Hayes et al. 1999; Teasdale et al. 2000). Observation and acceptance of emotions may also constitute exposure to emotions, which could result in a lower intensity of emotional responses over time (c.f. Lynch, Chapman, Rosenthal, Kuo, & Linehan, 2006). Recent brain imaging research suggests that one mechanism of mindfulness may be affective labelling, which promotes activity in the right ventrolateral prefrontal cortex, while inhibiting amygdala activity (Creswell, Way, Baldwin, Eisenberger, & Lieberman, 2007; Lieberman et al., 2007).

Primary Research Objectives and Hypotheses

Much of the extant research on suppression in BPD has been cross-sectional (Bijttebier & Vertommen, 1999; Rosenthal, Cheavens, Lejuez, & Lynch, 2005). Thus, it is impossible to ascertain the directionality of the relationship between suppression and some of the behavioural and emotional difficulties associated with BPD (e.g., negative emotionality, low distress tolerance) . Furthermore, existing experimental research on the effects of suppression have yielded mixed results, suggesting both positive (e.g., Dunn et al., 2009) and negative (e.g., Levitt et al., 2004) consequences of suppression as a way of coping with emotions. Given the importance of emotion regulation training in existing treatments for BPD, it is essential to clarify the effects of specific emotion regulation strategies within this population. Although a few studies have paved the way in this line of research (e.g., Chapman et al., 2009; Marissen, et al., 2010; Ruocco et al., 2010), these studies suffered several drawbacks. First, Chapman and colleagues focused on external validity, examining the effects of these strategies in daily life; however, this approach did not permit an examination of physiological or behavioural responding in the face of emotional stimuli. In contrast, other studies did not examine these strategies in response to ecologically meaningful emotional stimuli. The laboratory studies (Marissen et al., 2010; Ruocco et al., 2010) used standardized emotional stimuli (such as the IAPS, Lang et al., 2008), which are unlikely to represent the types of stressors experienced by individuals in their daily lives. Third, the emotion regulation instructions did not approximate the types of skills training used within clinical interventions for BPD. For instance, these studies provided brief instructions (e.g., "suppress" or "push away your emotions,"). Fourth, these studies have either compared undergraduate samples high and low in BPD features, or compared BPD participants with healthy controls. Given the association between general psychopathology with a tendency to suppress emotions (Purdon, 1999), it is unclear from these studies whether the findings are specific to BPD or apply more broadly. Finally, emotion regulation laboratory research has been plagued by inconsistent operationalizations of suppression. The extent of overlap that exists between emotion suppression, thought suppression, and expressive suppression remains unclear, as is the degree to which participants comply with emotion regulation instructions.

The focus of my dissertation research was to address these shortcomings, by examining the differential effects of emotion suppression training in the laboratory among individuals with BPD in response to ecologically meaningful stimuli, as compared with non-psychiatric controls and controls with major depressive disorder. The multimodal nature of the procedures permitted an examination of the subjective, physiological, and behavioural effects of specific emotion regulation strategies. Further, the inclusion of measures of facial muscle activity and a comprehensive manipulation check allowed for a discrimination between the instructed emotion suppression and other forms of suppression. Given the high levels of dysphoria experienced by individuals with BPD, it is necessary to compare the effects of emotion regulation strategies with other groups who experience negative emotions. Thus, we compared individuals with BPD to those with other psychiatric disorders, in order to control for the general effects of psychopathology. For the present research, major depressive disorder (MDD) was an ideal control group, controlling for the influence of dysphoric mood and baseline tendencies to suppress emotions.

For the present study, I examined the effects of emotion suppression and acceptance in the laboratory on outcomes that are important to BPD, such as physiological arousal, emotional distress, distress tolerance, and urges to engage in maladaptive behaviours such as non-suicidal self-injury, drug use, and binge eating.

Aim 1 for this research was to examine the effects of emotion suppression on self-reported emotions and psychophysiological responses. Hypothesis 1a was that suppression would result in heightened sympathetic and reduced parasympathetic arousal and lower levels of reported negative emotions compared with acceptance among individuals with BPD, MDD, and non-psychiatric controls. Based on previous research in our laboratory (Chapman et al., 2009; Dixon-Gordon et al., 2011), Hypothesis 1b was that BPD participants would exhibit greater sympathetic arousal and report more negative emotions and fewer positive emotions overall, compared with non-psychiatric controls and MDD participants. Hypothesis 1c was that there would be an interaction of diagnostic group and emotion regulation instructions, such that the effects of emotion regulation condition would be greater within the BPD group, compared with the other diagnostic groups.

The second aim for the present research was to examine the effects of emotion suppression on distress tolerance and subsequent urges to engage in maladaptive behaviours. Hypothesis 2a was that participants in the suppression condition would exhibit a shorter latency to quit the mirror tracing task compared with the acceptance condition in the laboratory, consistent with the resource depletion model which suggests that more regulatory efforts (i.e., suppression) would lead to less ability to tolerate subsequent stress. Hypothesis 2b was that individuals with BPD in the suppression condition would demonstrate a shorter latency to quit the mirror tracing task compared with MDD and non-psychiatric control groups in the suppression condition. Based on past research within our lab, Hypothesis 2c was that participants with BPD would report higher urges to engage in maladaptive behaviours overall, and that this relationship would be moderated by emotion regulation instructions, such that BPD participants would report higher urges in the acceptance condition, compared with the suppression condition.

The third aim of the present study was to examine the effects on emotion suppression on the identification of specific emotional states. Hypothesis 3 was that individuals in the suppression condition would demonstrate a tendency to endorse fewer specific emotions (e.g., sadness, anger), and more general, non-specific emotions (e.g., upset), particularly in the BPD group.

Methods

Participants

Individuals with BPD (n = 37; 86.48% female), major depressive disorder (MDD) (n = 33; 75.76% female) and controls with no history of or current psychiatric disorder (NPC) (n = 30; 76.67% female) completed the present study. This study included both males and females in order to enhance external validity, filling a gap left by studies that focus primarily on females with BPD, and to permit potential analysis of sex differences (given findings suggesting sex differences in emotion regulation; McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008). The sample was predominately Caucasian (39%) and East Asian (16%) (see Table 1), with an average age of 31.13 (SD = 10.91).

Table 1: Demographics

Race/ethnicity	N	%
Caucasian	49	49.0
East Asian	16	16.0
South Asian	4	4.0
Black/African Canadian	2	2.0
Southeast Asian	1	1.0
Other	9	9.0
More than one racial group	3	3.0
Chose not to answer	15	15.0

Inclusion and exclusion criteria.

Graduate research assistants trained to reliability (as indicated by 100% diagnostic agreement with a Ph.D. level clinician, Dr. Chapman, on two consecutive interviews) conducted diagnostic assessments using validated interviews. Inclusion criteria included: (a) *BPD group*: full diagnostic criteria met for BPD according to the Structured Clinical Interview for the *Diagnostic and Statistical Manual - III-TR* (SCID-II; First, Gibbon, Spitzer, Williams, & Benjamin, 1997), (b)

MDD group: MDE episode in the past year according to the Structured Clinical Interview for the DSM-IV-TR (SCID-I; First, Gibbon, Spitzer, & Williams, 2002), no SCID-II diagnosis of BPD, and minimal (<3) symptoms of BPD present, (c) *Non-Psychiatric Controls (NPCs)*: no current or history of any psychiatric disorder, and minimal symptoms of BPD present (< 3) (see Table 2).

Table 2: Inclusion and Exclusion Criteria

	BPD	**MDD**	**Non-psychiatric Controls**
Inclusion Criteria	19-60 years	19-60 years	19-60 years
	DSM-IV diagnosis of BPD	DSM-IV diagnosis of MDD	
Exclusion Criteria	Schizophrenia, schizophreniform, schizoaffective, and delusional disorders	Schizophrenia, schizophreniform, schizoaffective and delusional disorders disorders	Current or lifetime history of Axis I or Axis II DSM-IV diagnosis
	Bipolar Disorder	Bipolar Disorder	
	Epilepsy or seizure disorder	Epilepsy or seizure disorder	Epilepsy or seizure disorder
	GAD	3 or more BPD criteria	3 or more BPD criteria

Given the high prevalence of MDD among persons with BPD (83%, Zanarini et al., 1998; 89% in current sample), BPD participants with MDD were included to optimize external validity. Further, if both groups had significant depression, and differences were found in the effects of emotion regulation, group differences would be more likely to be attributable to BPD, specifically, rather than level of depressive symptoms. Participants who were currently manic or met full criteria for a specific psychotic disorder were excluded. People with substance use disorders or psychotic symptoms (but no diagnosis) were not excluded, as these disorders commonly co-occur with BPD (American Psychiatric Association, 2000), and I wished to maintain a clear and consistent focus on external and ecological validity. Finally, to examine the fidelity of diagnostic interviews, interviews were video and/or audio-recorded. Dr. Chapman coded a random sample of these interviews, and 100% agreement on inclusionary and exclusionary diagnoses was achieved.

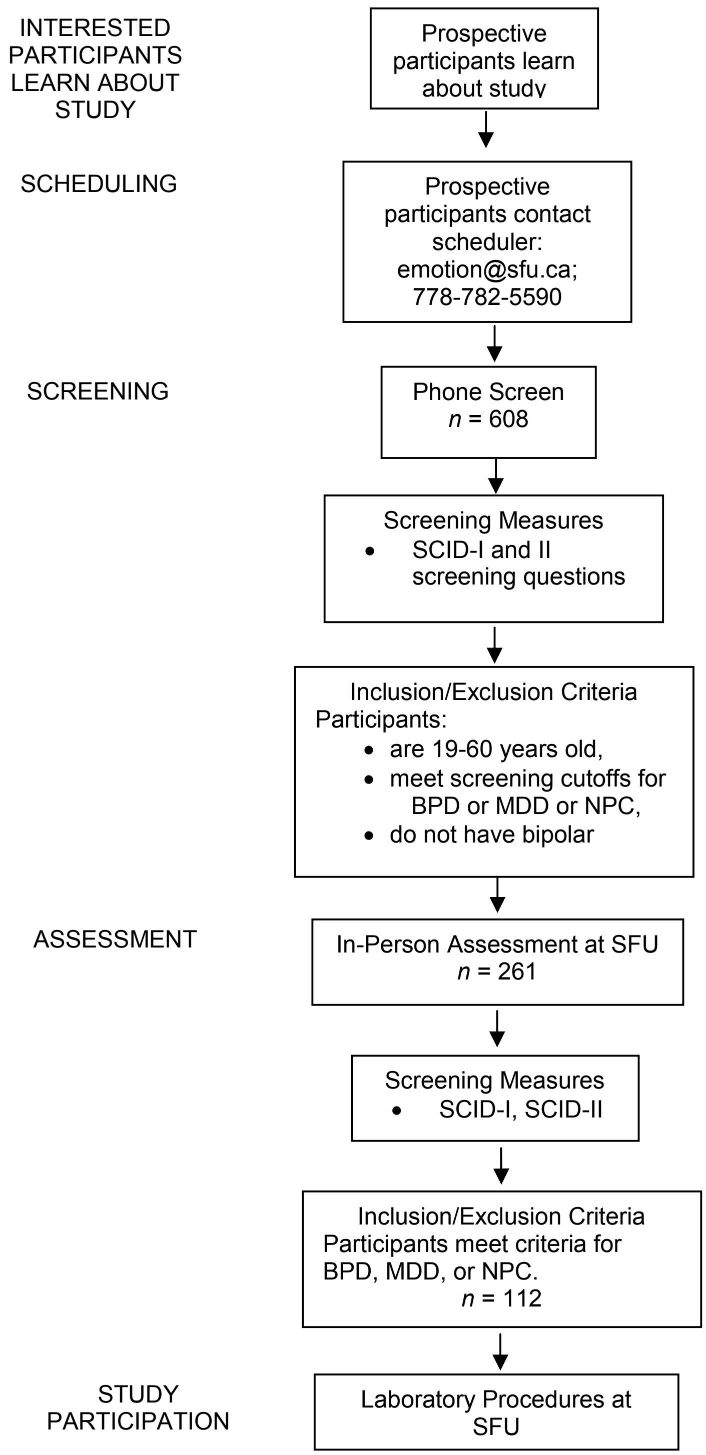
Participants were not excluded on the basis of their use of psychoactive medications. Patients with BPD or MDD are often prescribed psychoactive medications. Indeed, rates of psychotropic medication among this population range from 65 to 73% (e.g., Lynch et al., 2006; Zanarini et al., 2003). Excluding such individuals would likely have resulted in a less severe sample that does not represent patients who end up in treatment. The inclusion of participants using psychoactive medication optimizes the external validity and the treatment relevance of this research. In addition, there is also no reason to suspect that emotion suppression or acceptance would differentially influence medicated versus non-medicated participants. Nevertheless, I assessed and examined medication use (in particular, psychotropic medications and medications that relate to cardiovascular health, including antihypertension medication and stimulants) as a potential dichotomous covariate, consistent with prior psychophysiological research with similar samples (Crowell, Beauchaine, McCauley, Smith, & Vasiley, 2008).

Participants were not excluded based on the regular use of caffeine or nicotine. Although these substances may impact physiological measurement, excluding such individuals would have resulted in a restricted sample (18% used nicotine; 90% used caffeine). Participants were asked to refrain from using caffeine on the day of the laboratory procedures and to abstain from nicotine for 1 hour prior to the procedures, to ensure that neither nicotine intoxication nor withdrawal would impact the physiological measurements.

Recruitment.

Participants were recruited in several ways: (1) Primarily, participants for all three groups (MDD, BPD, and NPCs) were recruited by re-contacting participants who are currently or have participated in previous studies within our lab and consented to being contacted regarding opportunities for further participation; (2) Participants were also recruited via fliers and postings around the community and in cooperating hospitals and mental health clinics, geared towards people with a range of emotional difficulties (MDD and BPD-focused fliers were posted at participating hospitals and clinics; NPC fliers were posted throughout the community, including at bus stops, grocery stores, and libraries); and (3) MDD, BPD, and NPC participants were recruited via website advertisements. The SFU Clinical Psychology Centre and the Dialectical Behaviour Therapy Centre of Vancouver served as additional recruitment sources. Dr. Chapman has established working relationships with the Fraser Health system of hospitals, medical and mental health clinics and received ethics approval for this project from Fraser Health as well as permission to post fliers and recruit participants from their sites. Local treatment providers and mental health directors (at Vancouver General Hospital and Burnaby Addictions and Mental Health) also contributed to recruitment by posting fliers at their clinics (see Figure 1 for flow of recruitment).

Figure 1: Participant recruitment and screening procedures



Procedures

Assessment.

All prospective participants were screened initially through a brief phone interview. Before asking any questions, the phone interviewers read the informed consent aloud, briefly described the study, asked about age and gender, and asked screening questions from the Structured Clinical Interview for the DSM-IV (SCID) for Axis I disorders and for BPD. In order to meet inclusion and exclusion criteria for the NPC group, participants had to deny all screening questions for Axis I disorders, and endorse no more than 3 criteria for BPD. To meet criteria to be invited for the diagnostic assessment for the MDD group, participants were required to report an episode of depression, deny any history of mania in the manic screening question, and endorse no more than 3 criteria for BPD. For BPD participants to be invited for a diagnostic assessment, they needed to endorse five or more BPD criteria, and deny history of mania. If the participants did not meet any exclusion criteria in this initial phone interview, a diagnostic assessment was scheduled. If participants met inclusion and did not meet exclusion criteria during the diagnostic assessment, they were invited to return for the laboratory component of the study.

Diagnostic interview for Axis I.

The SCID-I (First et al., 2002) was used as the primary instrument for obtaining Axis I diagnoses. The SCID-I is a widely used semi-structured psychiatric interview designed to determine accurate diagnoses on Axis I of the DSM-IV. The SCID leads to more accurate diagnoses than unstructured interviews (Basco et al., 2000). The SCID-I has high levels of inter-rater (κs = -.02 – 1; Segal, Hersen, Van Hasselt, Kabacoff, &

Roth, 1993; Skre, Onstad, Torgerson, & Kringlen, 1991) and test-retest (κs = .37 - .89; Williams, Spitzer, & Gibbon, 1992; Malow, West, Williams, & Sutker, 1989) reliability (Segal, Hersen, & Van Hasselt, 1994).

Diagnostic interview for Axis II.

The SCID-II (First et al., 1997) was used as the primary instrument for obtaining Axis II diagnoses. Responses to interview questions are rated as present, absent, or sub-threshold. The authors reported adequate inter-rater reliability of previous iterations of this instrument (κs = .24 - .74) within a clinical sample (First et al., 1995). Other researchers (Maffei et al., 1997) have found adequate inter-rater reliability (κ = .48 - .98), particularly for dimensional scores (intraclass correlation coefficients, .90 - .98), and satisfactory internal consistency (α = .71 - .94).

Risk assessment procedures.

Our research lab has effectively dealt with potential risks in conducting research with high-risk populations, using a protocol originally developed by Dr. Marsha Linehan at the University of Washington for research on suicidal women with BPD. Before and after each session, participants were asked to rate their level of distress and urges to engage in impulsive, self-damaging behaviours on a scale of 1 to 7. Then, they were asked to brainstorm strategies they could use to reduce distress if it should arise. If a participant reported high suicidal ideation or homicidal ideation (operationalized as a 4 or greater on a scale of 1-7), a risk management protocol was implemented. This involved contacting clinical backup, a masters- or doctoral-level clinician (including the first author and Dr. Chapman), inquiring about risk factors such as the presence of a suicide plan or access to lethal means, offering the participant positive emotion induction strategies in the meantime, and connecting the participant with medical or treatment resources. The participant was accompanied by a research assistant until the clinical backup established a safety plan, which included reduction of risk and connection with resources.

Laboratory procedures.

The experiment was conducted in a sound-attenuated room maintained at 68 degrees Fahrenheit. A one-way mirror separated the experimental room from the observation room, so that participants could be monitored while undergoing the experiment. After the participants were familiarized with the laboratory setting, baseline self-report questionnaires (see below) were administered. Next, the physiological equipment was attached and checked. The participants then rated their initial level of emotions and urges to engage in maladaptive behaviours. Experimenters asked participants to sit still for 5 minutes while physiological responding is assessed (true baseline 1; described below). Next, experimenters instructed participants to engage in another baseline measurement period, while completing concurrent emotion ratings (described below). Participants completed a second set of emotion ratings and then listened to either Accept or Suppress emotion regulation instructions. Participants then underwent the emotion induction: they listened to a stressful social rejection imaginal scenario (described below). After the emotion induction, participants completed a third set of emotion ratings and indicated how they managed their emotions (a manipulation check). Next, participants were instructed to complete a computerized task designed to measure distress tolerance (the Computerized Mirror Tracing Persistence Task, or

MTPT-C; Strong et al., 2003, described below). They were then asked to complete a fourth set of emotion ratings and also report their urges. Finally, participants were told to sit still for another 5-minute true baseline (see Table 3 for order of procedures).

Table 3: Flow and Duration of Laboratory Procedures

Procedure	Average Duration
Completion of self-report measures (BSI, MHHI, re-administration of the PAI-BOR)	10 min
Risk Assessment (UWRAP)	5 min
Hook-up to Biopac equipment	10 min
Completion of PANAS, DSS, behavioural urges	5 min
True Baseline Measurement (Baseline) Ω	5 min
True Baseline with Emotion Reporting Ω	5 min
Completion of PANAS and DSS	2 min
Instructions: Accept or Suppress	10 min
Social Rejection Audio-recording with Emotion Reporting Ω	5 min
Completion of PANAS, DSS, behavioural urges, manipulation check	7 min
Mirror Tracing Task	5-10 min
Completion of PANAS, DSS, behavioural urges	5 min
True Baseline Measurement (Recovery Period) Ω	5 min
Completion of PANAS, DSS, manipulation check	5 min
Debriefing Procedures	5 min
Removal of Biopac equipment	5 min
Total Duration	95-100 min

Note. BSI = Brief Symptom Inventory, MHHI = Medical Health History Interview, PAI-BOR = Personality Assessment Inventory, Borderline Features Scale. UWRAP = University of Washington Risk Assessment Procedure, PANAS = Positive and Negative Affect Schedule, DSS = Dissociation Tension Scale. **Ω** *= Psychophysiology measurement period*

Physiological measures.

All physiological measures were acquired using Ag/AgCl electrodes, and through BIOPAC Systems amplifiers and scored using BIOPAC (BIOPAC Systems, Inc., Santa Barbara, CA), Mindware (Mindware Technologies, LTD., Gahanna, OH) or MatLab (MathWorks, Natick, MA) software.

*Respiratory sinus arrhythmia***.**

Respiratory sinus arrhythmia (RSA) was assessed as an index of vagal tone. RSA was measured by assessing the high-frequency band of spectral analysis, which constitutes the range greater than .15 Hz, which is thought to be a measure of parasympathetic activity. Low RSA has been associated with negative affect in several clinical samples compared with non-psychiatric controls (Asmundson & Stein, 1994; Grossman, Karemaker, & Wieing, 1991; Lyonfields, Borkovec & Thayer, 1995). RSA can be conceptualized as the amount of fluctuation in heart rate throughout the respiration cycle. Once the influence of respiration has been removed, RSA can be used as an index of vagal tone (Grossman & Taylor, 2007). Reactivity of RSA is associated with activity in the parasympathetic nervous system, and therefore low RSA (less "resting" influence) is associated with fight or flight responding. Research on group differences between BPD and non-BPD control participants indicates that BPD individuals tend to respond to emotional arousal with a gradual decrease in RSA, whereas non-BPD participants respond with an increase in RSA (Austin et al., 2007). This finding is consistent with persons with BPD responding to conflict with an escalation of the sympathetic response ("fight or flight") and an inhibition of the parasympathetic system.

Cardiac pre-ejection period.

Cardiac pre-ejection period (PEP) is the period of time between the depolarization of the left ventricle and the ejection of blood into the circulatory system (Kelsey & Guethlein, 1990). Research indicates that decreases in PEP are associated with regulation of negative emotional experiences (Demaree, Pu, Robinson, Schmeichel, & Everhart, 2006).

Skin conductance level.

Skin conductance level (SC), another measure of sympathetic activity, refers to the level of conductance of a small electrical current as it passes from one sensor to another across the hand. Changes in SC occur in response to perspiration rising through glands in the hand, and are usually associated arousal and attention. SC was recorded from two collars with electrodes attached to the second and third distal phalanges on the non-dominant hand. This data is particularly useful in the present study, as increases in SC have been associated with fear of emotions and negative affect following exposure to emotional stimuli, even when cardiac measures did not change significantly (Salters-Pedneault, Gentes, & Roemer, 2007). The SC data were collected through an MP100WS system at the rate of 1000 samples per second.

Electromyography.

Facial electromyography (EMG) recordings of skeletomotor activation over participants' *zygomaticus major* (cheek region) and *corrugator supercilii* (eyebrow region) sites were obtained according to the guidelines of Fridlund and Cacioppo (1986). Activation of the *zygomaticus major* and *corrugator supercilii* are associated with positive and negative emotional expressivity, respectively (Cacioppo, Petty, Losch, &

Kim, 2008). Data were collected using Acqknowledge, with a sampling rate of 1000Hz, then band-pass filtered (20 – 450 Hz passband), full-wave rectified, and integrated offline, using an algorithm implemented in MATLAB. Gross zygomatic and corrugator activation were then separately assessed for each experimental phase by taking each filtered, rectified voltage-time function and calculating the arithmetic mean amplitude.

Laboratory tasks.

True baseline.

Prior to the first emotion induction, participants engaged in a 5-minute "true baseline" where they were instructed to sit still.

Imaginal emotion induction procedures.

The induction procedure required that participants listen to a five-minute audio-recording. Participants were instructed to close their eyes, listen carefully, and imagine that the events described were happening to them. They were asked to picture the events in their minds, and to allow themselves to feel how they would respond to these events in real life.

The tape portrays a social rejection scenario. The protagonist (referred to by the tape in the second-person) is described as new in town. The tape describes the protagonist calling her boyfriend, and another female answers his telephone. Later, the protagonist overhears two of her friends criticizing her appearance, behaviour, and values. These friends also discuss the purported infidelity of the boyfriend (see Appendix A for example of script).

This recording has been found to cause significant increase in negative affect in an undergraduate sample (Robins, 1988). For the present study, the recording was modified to state that the protagonist was “new in town”, rather than “new to the university.” Furthermore, several versions were created to allow for presentation to a male or female heterosexual or homosexual participant. Within our lab, this emotion induction has elicited negative emotions as measured by self-report, and increases in physiological arousal among participants high and low in BPD features (Dixon-Gordon, Chapman, Lovasz, & Walters, 2011). This procedure was chosen to allow for psychophysiological data collection to occur throughout the activity, so an emotion induction procedure that required minimal movement was necessary.

Emotion suppression and acceptance instructions.

I adapted the emotion regulation instructions by Levitt and colleagues (Levitt et al. 2004) for anxiety, making them relevant to negative emotions more generally. Participants were told to listen carefully to audio-recordings describing a way to cope with their experiences during a subsequent task. These instructions provided a ten-minute rationale for the use of a specific emotion regulation strategy. In this way, these instructions are similar to brief therapeutic interventions (e.g., Hayes, Strosahl, & Wilson, 1999). In the suppression instructions, participants were told that they “can control negative emotions,” and should “pay attention to negative feelings and push them away.” The acceptance instructions, on the other hand, told participants that “Being willing to experience your thoughts and feelings, good and bad, can free you up to focus on what really matters in your life… allow yourself to feel whatever emotions come up for you. Stop trying to control your negative emotions, just let them be” (see Appendix B for instructions).

Computerized mirror tracing persistence task.

We used a computerized version of the Mirror Tracing Persistence Task (MTPT; Quinn, Brandon, & Copeland, 1996), the MTPT-C (Strong et al., 2003), to measure distress tolerance. Participants were required to trace three figures on a computer screen, using a computer mouse. The participants were informed that the cursor on the screen moved in the opposite direction of the mouse. For instance, if the participant moved the mouse to the left, then the cursor moved to the right. If the participant moves the cursor outside of the lines of the star, or if the participant did not move the mouse for more than 2 seconds, then a buzzing sound occurred, and the cursor returned to the starting point. The first two figures were easy, whereas the third figure, a star, was more difficult. On the third figure, participants had the option to quit the task. Participants were told that they could end the task at any time by pressing a key, but that how well they did on the task would affect how much money they would be paid. If the participant did not end the task by seven minutes, the task was terminated. Psychological distress tolerance was operationalized as latency in seconds to task termination. The MTPT-C has demonstrated good convergent and divergent validity. Performance on the MTPT-C has been shown to correlate with performance on another behavioural measure of distress tolerance, a frustrating, sequential addition task (Schloss & Haaga, 2011). In addition, longer latencies to terminate the MTPT-C were a significant predictor of treatment drop-out among substance users (Daughters et al., 2005). The MTPT-C has been shown to increase negative emotions, such as irritability (Bornovalova et al., 2008; Gratz, Bornovalova, Delany-Brumsey, Nick, & Lejuez, 2007). These studies suggest, however, that latency to quit the MTPT-C is not simply a measure of skill or distress. Participants with substance use disorders and BPD tend to terminate the task earlier, compared with substance users without BPD (Bornovalova et al., 2008). Past research on behavioural distress tolerance measures within BPD samples suggests that participants who quit the task generally terminate early on (e.g., minimum of 39 seconds; Gratz et al., 2006).

Baseline Self-Report Measures

Borderline personality features.

The Personality Assessment Inventory-Borderline Scale (PAI-BOR; Morey, 1991) contains 25 items, with each rated on a 4-point scale (where 0 is "completely false," and 3 is "very true"), and assesses the severity of BPD features. This measure has been used to assess BPD features in several studies (Chapman et al., 2008; Chapman et al., 2009; Trull, 1995; 2001). When using a cut-off of 38, the PAI-BOR demonstrated high positive predictive power when referenced to a BPD diagnosis on the SCID-II (Jacobo, Blais, Baity, & Harley, 2007). The PAI-BOR has strong psychometric properties, and good test-retest reliability at a one month interval (rs < .89) in samples of university students (Chapman et al., 2008; 2009; Chapman, Dixon-Gordon, Layden, & Walters, 2010). In the present study, the PAI-BOR had good internal consistency (α = .94).

Depressive symptoms.

The Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) was used to assess depressive symptoms. This measure includes 21 multiple-choice items. Each choice is assigned a value from 0 to 3, where greater values are associated with greater severity of depression. Scores on the BDI have been correlated with number of depressive symptoms on the SCID-I (Sprinkle et al., 2002). A cut-off score of 15 resulted in a sensitivity rate of 84%. In the present study, the BDI-II demonstrated very good internal consistency, $\alpha = .95$.

Trait measures of emotion regulation tendencies.

The Difficulties with Emotion Regulation Scale assessed emotion regulation problems (DERS; Gratz & Roemer 2004). The DERS was designed to assess multiple aspects of emotion dysregulation, including non-acceptance of emotions, difficulties pursuing goals in the presence of intense emotions, impulse control difficulties, lack of emotional awareness, limited emotion regulation strategies, and lack of emotional clarity. This measure has been associated with instruments assessing expectancies about managing negative emotions and experiential avoidance. Further, the DERS predicted frequency of behaviours commonly associated with emotion dysregulation, including self-harm and violence. In the present study, the total score had high internal consistency ($\alpha = .96$), and the subscales also demonstrated acceptable internal consistency (αs = .80-.93).

Baseline tendencies to engage in suppression were assessed with the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003; Gross & Levenson, 1997). This self-report measure consists of 10 items rated on a Likert scale from 1 to 7, where 1 indicates "strongly disagree" and 7 indicates "strongly agree." This measure has two factors: (1) reappraisal (e.g., "When I wanted to feel less *negative* emotion, I *changed the way I was thinking* about the situation"), referred to more generally as cognitive control in this paper, and (2) suppression (e.g., "I controlled my emotions by *not expressing them*"); more specifically, *expressive* suppression. Among an undergraduate sample, this measure has adequate three-month test-retest reliability ($r = .69$) (Gross & John, 2003).

For the present sample, internal consistency within each factor was good (α = .86 for reappraisal, and α = .73 for suppression).

Experiential avoidance was assessed with the Acceptance and Action Questionnaire (AAQ; Hayes et al., 2004), a 9-item self-report measure of experiential avoidance. Each item is rated on a 7-point Likert scale. These items tap into tendencies to make negative evaluation of internal experiences (e.g., “anxiety is bad”), as well as unwillingness to experience such aversive events. Studies evaluating the validity of the AAQ demonstrate that higher scores are associated with more fear of emotions, poorer job performance, poorer overall mental health, and increased likelihood of meeting criteria for a mood or anxiety disorder (c.f., Bond & Bunce, 2003). Scores on the AAQ typically have high internal consistency (e.g., α = .89, Kashdan, Barrios, Forsyth, & Steger, 2006). The internal consistency of the AAQ was acceptable in the present study (α = .78).

Furthermore, the tendency to be mindful of emotions and other experiences was assessed with the Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003). This scale assesses one aspect of dispositional mindfulness. The MAAS has been found to have strong psychometric properties, and is correlated with self-regulation. In the present study, the MAAS exhibited acceptable internal consistency (α = .93).

Alexithymia.

To assess baseline difficulties identifying and describing emotions, I used the Toronto Alexithymia Scale – 20 (TAS-20; Bagby, Parker, & Taylor, 1994a;b). This measure contains 20 items, each of which is rated on a 5-point scale. Higher scores indicate higher levels of agreement with the items. In addition to a total score, the measure consists of three subscales, including difficulty identifying feelings, difficulty describing feelings to others, and externally oriented thinking, or a tendency to avoid introspection. The TAS-20 is negatively associated with psychological mindedness and positively associated with negative and observer ratings of alexithymia (Bagby et al., 1994). In the present study, the measure exhibited adequate internal consistency (α = .87).

Medical history.

The Medical Health History Interview for Physiological Research (MHHI; Beauchaine, 1993) is a brief structured interview modified for use as a questionnaire to identify medical factors that might interfere with accurate assessment of physiological variables.

Self-Report Measures During Laboratory Procedures

Dissociative State Scale.

The Dissociation-Tension Scale (DSS; Stiglmayr, Shapiro, Stieglitz, Limberger, & Bohus, 2001; Stiglmayr et al., 2010) was used to assess the change in severity of dissociative symptoms. This self-report measure consists of 19 items that relate to physiological (e.g. “hearing things as if from far away”) and psychological dissociation (e.g., “feel as though I am standing beside myself”). Items are rated on a 10 point scale of intensity, where 9 is “none,” and 9 is “very strong.” Higher scores relate to more severe dissociative symptoms. Within a BPD sample, the developers found split-half reliability was very good, $r = .92$. Scores on the DSS are correlated with BPD symptoms and other measures of trait dissociation, but not correlated with other personality measures. This measure had high internal consistency in the present study, αs = .89 - .93. Scores on the DSS were related to physiological arousal in response to a startle probe among individuals with BPD and controls, and therefore may be useful to avoid confounding arousal with dissociation (Ebner-Priemer et al., 2005).

Current subjective emotional state.

The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to assess subjective emotional state. Participants rated how much they feel each of ten positive emotions (enthusiastic, interested, determined, excited, inspired, alert, active, strong, proud, attentive) and ten negative emotions (scared, afraid, upset, distressed, jittery, nervous, ashamed, guilty, irritable, hostile) "right now, at the present moment" on a Likert scale from 1 to 5. The PANAS has shown good test-retest reliability over eight weeks (r = .68 for Positive Affect, r = .71 for Negative Affect) among a sample of students (Watson et al., 1988) as well as good convergent validity (MacKinnon et al., 1999). In the present study, both the positive (αs = .90 - .93) and negative scales (αs = .92-.93) demonstrated good internal consistency.

Concurrent subjective emotional report.

To examine the impact of emotion regulation instructions on the process of recognition of specific emotions during the emotion induction, participants were asked to indicate which emotions they experience, as they notice them. An array of 16 emotion words (selected from the PANAS, with the addition of "angry") was displayed on the screen. Participants were instructed to click on each emotion, as they notice it. Participants were given the opportunity to gain practice with this assessment tool by testing the concurrent subjective emotional report prior to engaging in the concurrent self-report during the baseline period. Participants also completed concurrent subjective emotional report during the social rejection audio-recording. The emotion terms and response times were recorded.

Manipulation check.

A manipulation check, assessing which emotion regulation strategies were used during the emotion induction, was derived from the ERQ (described above) as well as additional items (such as "pushed my emotions away" or "just noticed my emotions." These questions have been used previously in our research (see Chapman et al., 2009). Additional items were selected from the Responses to Emotions Questionnaire (REQ; Campbell-Sills et al., 2006). Each of these eight items were rated on a 9-point Likert scale. Four of these items assess various strategies of regulating emotions (suppression, distraction, reappraisal, attention redirection) and four items assess emotional acceptance (e.g., "I didn't mind feeling uncomfortable during the tape"). Subscales were computed based on an exploratory factor analysis (described below) resulting in five factors: (1) Reappraisal, (2) Emotion Suppression, (3) Acceptance, (4) Expressive Suppression, and (5) Dissociation. Internal consistency for the first four factors was good, αs = .70 - .87, but internal consistency was not adequate for the Dissociation factor, α = .53.

Urges to engage in maladaptive behaviours.

Questions developed in our laboratory were administered to assess level of urges (on a scale of 1, "not at all or very slightly," to 5, "extremely") to engage in maladaptive behaviours (substance use, non-suicidal self-injury, reckless driving, spending money, bingeing, purging, sexual activity, or violence) and that have been used previously in our research (see Chapman et al., 2009). These questions were administered during the laboratory procedures. The sum of these urges exhibited good internal consistency in past research (α = .77; Chapman et al., 2009) and in the present study (αs = 87 - .89).

Data Analytic Plan

Preliminary power analyses and sample size considerations.

According to Cohen's (1992) recommendations, previous research has demonstrated small to large effects in emotion regulation laboratory studies. For instance, pilot research for the present study revealed small to large effect sizes (η^2 = 0 - .27, with a mode of .13) of Group x Condition analyses. Previous studies of the effects of suppression on mood have found effect sizes that range from small (e.g., Campbell-Sills et al., 2006) to medium and large (e.g., Levitt et al., 2004; Salters-Pedneault et al., 2007). Based on these expected medium to large effect sizes, and the anticipated analyses, I expected that 14 participants per cell would provide power >.80 (large effects, f^2 = .35; α = .05; two-tailed) for a 3 (BPD vs. NPC vs. MDD) x 3 (Time) x 2 (Accept, Suppress) general linear model analysis (Cohen, 1992). This requires 28 participants per diagnostic group, for a total of 84 participants. Similarly, a power analysis for a generic *F* test with medium to large effect sizes suggested that a sample size of 75 would yield power > 90 (Faul, Erdfelder, Lang, & Buchner, 2007).

Descriptive statistics and data transformations.

Prior to beginning data analysis, I examined the descriptive statistics and the distribution properties of the dependent variables (self-reported emotional state on

PANAS, SC, RSA, PEP, latency to quit the distress tolerance task, and urges to engage in maladaptive behaviours). Variables were inspected for non-normality (skew > 2.0, kurtosis > 7.0) (Curran, West, & Finch, 1996). Extremely skewed or kurtotic variables were logarithmically (base 10) transformed, consistent with recommended guidelines (Hamilton, 1992). In addition, residual plots and normal quantile plots were examined to assess for multivariate normality. Prior to entry into the primary analyses, all continuous variables were centered using transformation to *Z* scores.

Outliers.

Extreme outliers (greater than 3 times the interquartile range above the upper quartile value) within each group (NPC, MDD, BPD) were identified and replaced the outlying scores with the most extreme valid values. Winsorizing outliers in this manner can increase power without significantly increasing Type I errors (Bollinger & Chandra, 2005).

Missing data.

Data was inspected for inconsistent responses, and excluded on this basis. I excluded physiological data if there were technical errors or artefacts. Missing data bias was assessed by computing dummy variables for all dependent variables reflecting the presence or absence of missing data. These dummy variables were correlated with key variables, including age, sex, emotion regulation condition, and dummy coded variables for diagnostic category and ethnicity. A Bonferroni correction was applied to each family of tests. Each family of tests was defined as the tests of the strength of the correlations between each key variable and the 15 dummy-coded variables signifying missing physiological data (α = .05 divided by 15 leading to α = .003), and the tests of the correlations between each key variable and the 7 dummy-coded variables indicating missing self-report data (α = .05 divided by 7 leading to α = .007). Where possible, parameters were estimated using restricted maximum likelihood estimates. For all other analyses, missing cases were excluded listwise for each analysis.

Identification of covariates.

I examined the associations of the dependent variables with potential covariates, including medication, drug/alcohol use, age, weight, ethnicity, trait measures, and dissociation during the emotion induction. Investigation of these variables as potential covariates is important, in light of findings that several physiological indices (e.g., respiratory sinus arrhythmia) correlate with age, and that ethnicity is linked to differences in physiological reactivity (Friedman & Thayer, 1998; Anderson & McNeilly, 1991). If any such variables were associated with the dependent variables, I included the variables as covariates in the relevant analyses.

Primary analyses.

All analyses were conducted using SPSS, Version 19.0 (IBM SPSS, Chicago, IL). For each hypothesis, a Bonferroni correction was applied to subsequent pairwise comparisons, dividing α = .05 by the number of comparisons made, to correct for family-wise error.

Sample composition.

The sample composition across conditions and groups was examined in order to rule out differences in individual characteristics as potential confounds. To assess any differences between conditions or groups on dichotomous variables, such as use of medication, or other categorical variables, such as ethnicity, a $\chi 2$ test was used to test differences in proportions across conditions. Differences in other demographic variables, including age and sex, were assessed. Differences in medication status were also examined across conditions and groups. In addition, I also assessed differences between conditions in terms of emotionality and tendency to use emotion regulation strategies. For measures with multiple subscales, I used a multivariate analysis of variance (MANOVA) with Condition as the independent variable (IV) and the subscale scores as the dependent variables (DVs). For the other measures, I used independent *t* tests to test differences between conditions.

Manipulation check.

Because the manipulation check contained items combined from several measures (e.g., the ERQ and REQ; Campbell-Sills et al., 2006; Chapman et al., 2009; Gross & John, 2003), I first examined the structure of these items with an exploratory factor analysis (EFA in SPSS, using maximum likelihood extraction with direct oblimin rotation to allow factors to correlate, per Costello & Osborne, 2005). To determine the number of factors, I evaluated the scree plot from an EFA without constraining the number of factors. Based on this examination, I conducted an EFA constrained in terms of factors (with delta set to zero). Items were retained if they loaded .32 or above on a factor; items which crossloaded were discarded (per Tabachnick & Fidell, 2001).

With these factors as dependent variables, a 3 (Group: NPC, MDD, or BPD) x 2 (Condition: Accept or Suppress) MANOVA was used to examine the effect of the emotion regulation instructions on reported use of emotion regulation strategies.

Aim 1.

The effects of emotion regulation and diagnosis on emotional reactivity was examined using a general linear mixed model (GLMM) approach. The GLMM is a generalization of the classic linear model, which permits modeling of variance and covariance, in addition to fixed effects (Arnau, Balluerka, Bono, & Gorostiaga, 2010). In this manner, the GLMM allows for inconstant correlation and variability. One advantage of the GLMM approach over standard repeated-measure analysis of variance is that it allows for the inclusion of cases with missing values, thereby providing a better estimate of the effects on the sample (Krueger & Tian, 2004). Thus, even a participant with only one time point can contribute to the estimation of the within residual error and the random intercept term. The participant's slope is set to the "population-averaged" slope. This analytic approach is therefore particularly well-suited to the present study, due to the extent of data loss.

Within the GLMM approach, a two-step procedure was implemented. First, the covariance structure was fitted using restricted maximum likelihood. Restricted maximum likelihood estimation is preferred to full maximum likelihood estimation with small samples, because it produces a less biased result, estimating random components by averaging over all possible fixed effects values (Figuerdo & Olderbak, 2008). Within a repeated measurements context, the repeated observations within subjects (at baseline, emotion induction, and recovery) comprise the first level of the model. Because the relationship of the dependent variables across time was not expected to be linear, given the anticipated effects of the emotion induction, a piecewise linear model was created, with the slope change at the emotion induction (Heck, Thomas, & Tabata, 2010). The covariance matrices for the first and second levels were chosen based on information characteristics, consistent with guidelines by Heck and colleagues. A Bonferroni correction was applied to correct for multiple comparisons, using $\alpha = .05$ divided by the number of comparisons, unless otherwise specified. A model R^2 was calculated for each model, defined by using the likelihood ratio test comparing the full model to a null model with the same covariance structure, but all fixed effects (except the intercept) removed (Edwards, Muller, Qaqish, & Schabenberger, 2008). Thus, the R^2_L is a measure of the multivariate association between the fixed effects and the outcomes in the GLMM.

Aim 2.

To examine the effect of emotion regulation on distress tolerance, I conducted a 3 (Group: NPC, MDD, or BPD) x 2 (Condition: Accept or Suppress) univariate analysis of variance (ANOVA), or covariance (ANCOVA), with latency to discontinue the mirror-tracing task as the dependent variable. Because of the large variability in these data, I also undertook a secondary set of analyses of binary variables, including Quit/No quit of the mirror-tracing task within 45 seconds. Using logistic regression (Williams, 2006), I evaluated the effects of Group, Condition, and Group x Condition on both binary variables. Group was entered as two dummy-coded variables as predictors. In step 1, I entered BPD diagnosis. In step 2, MDD diagnosis was entered. Condition was entered in step 3. If the model remained significant, Condition x Group was entered in step 4. I employed the GLMM approach described above to evaluate the effects of Group and Condition over Time on urges to engage in maladaptive behaviours.

Aim 3.

To examine the effect of emotion regulation and diagnosis on specificity of emotion identification, a Group x Condition x Time analysis was conducted. Due to the data loss with regard to the concurrent emotion reporting, the sample size was lower than recommended for a GLMM approach, and might result in a biased estimation of the model (Heck et al., 2010). Therefore, I used a repeated measures analysis of variance to address this aim (Littell, Milliken, Stroup, & Wofinger, 1996).

Results

Preliminary Analyses and Data Preparation

Descriptive statistics and data transformations.

Both the self-report and psychophysiological variables (with the exception of corrugator EMG) were substantially positively skewed and leptokurtic (skew > 2.0, kurtosis > 7.0) (Curran et al., 1996). Therefore, all laboratory self-report and psychophsyiological variables were logarithmically (base 10) transformed, consistent with recommended guidelines (Hamilton, 1992). These transformations resulted in more normal distribution properties (skewness = -2.12 - 2.70; kurtosis = -1.06 – 9.84), although the EMG zygomatic values during the recovery period were still leptokurtic (kurtosis = 9.84; see Table 4 for the association of self-report and physiological variables). In addition, residual plots and normal quantile plots appeared consistent with the assumption of multivariate normality. Large variability was observed within the latency to quit the mirror tracing task scores. Therefore, this variable was transformed into a dichotomous variable (quit within the first 45 seconds, given the tendency for BPD participants to discontinue tasks early on; Gratz et al., 2006) for follow-up analyses (see Tables 5 and 6 for self-report descriptives; see Tables 7, 8, 9, 10 and 11 for physiological descriptives; see Table 12 for mirror tracing task descriptives).

Table 4: Correlations of Reported Emotions and Physiological Indices

	Negative Emotion	Positive Emotion	PEP	SCL	RSA	EMG-C
			Baseline			
PEP	-.10	.14	-	-	-	-
SCL	-.24*	.02	.04	-	-	-
RSA	.07	.05	.05	-.05	-	-
EMG-C	.07	-.17	.05	-.15	.19	-
EMG-Z	.14	.04	.05	-.19	.22*	.47**
			Emotion Induction			
PEP	-.14	.15	-	-	-	-
SCL	-.21*	-.01	-.02	-	-	-
RSA	-.11	.13	.36**	-.02	-	-
EMG-C	.14	-.06	.04	-.21	.07	-
EMG-Z	.04	.08	-.02	-.24*	-.04	.25*
			Post-Mirror Tracing			
PEP	-.08	.09	-	-	-	-
SCL	-.24*	.08	.15	-	-	-
RSA	.04	.06	.08	-.10	-	-
EMG-C	.22	-.18	.08	-.09	-.10	-
EMG-Z	-.03	.14	.08	-.20	-.11	.13

Note: This table presents transformed scores. EMG-C = Electromyography Corrugator Activity; EMG-Z = Electromyography Zygomatic Activity; PEP = Cardiac Pre-ejection Period; RSA = Respiratory Sinus Arrhythmia; SCL = Skin Conductance Level.

** Significant at the .05 level.*

*** Significant at the .01 level.*

Table 5: Descriptive Statistics of Reported Emotions on the Positive and Negative Affect Schedule

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC				
Positive Affect	10.00-50.00	22.47 (1.86)	.74 (.43)	.94 (.83)
Negative Affect	10.00-23.00	12.17 (3.35)	2.28 (.43)	4.68 (.83)
MDD				
Positive Affect	10.00-37.00	17.66 (6.9)	1.02 (.43)	2.82 (.85)
Negative Affect	10.00-26.00	14.86(5.03)	.93 (.43)	-.27 (.85)
BPD				
Positive Affect	10.00-34.00	17.21 (5.5)	1.06 (.40)	1.55 (.79)
Negative Affect	10.00-45.00	18.35 (8.59)	1.63 (.40)	2.43 (.79)
		Post-Emotion Induction		
NPC				
Positive Affect	10.00-40.00	22.47 (1.86)	1.04 (.43)	.94 (.83)
Negative Affect	10.00-25.00	14.03 (5.08)	.99 (.43)	-.48 (.83)
MDD				
Positive Affect	10.00-38.00	18.48 (6.73)	1.58 (.43)	2.82 (.85)
Negative Affect	10.00-34.00	16.56 (5.82)	1.58 (.41)	2.91 (.81)
BPD				
Positive Affect	10.00-30.00	16.12 (4.64)	1.35 (.40)	1.77 (.79)
Negative Affect	10.00-45.00	20.68 (9.68)	.93 (.40)	-.19 (.79)
		Post-Mirror Tracing		
NPC				
Positive Affect	10.00-26.00	19.70 (9.31)	1.02 (.43)	.40 (.83)
Negative Affect	10.00-23.00	12.40 (3.62)	1.75 (.43)	2.26 (.83)
MDD				
Positive Affect	10.00-39.00	16.45 (6.91)	1.76 (.43)	3.2 (.85)
Negative Affect	10.00-39.00	14.25 (6.15)	2.62 (.41)	8.27 (.81)
BPD				
Positive Affect	10.00-32.00	16.09 (5.7)	1.23 (.40)	1.09 (.79)
Negative Affect	10.00-39.00	16.38 (8.74)	1.56 (.40)	1.18 (.79)

Note: This table presents raw, non-transformed scores.

Table 6: Descriptive Statistics of Reported Urges

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC	13.00-28.00	16.33 (3.73)	1.72 (.43)	2.34 (.83)
MDD	13.00-23.00	16.63 (2.94)	.87(.43)	-.56 (.83)
BPD	0.00-44.00	20.26 (9.47)	.61 (.40)	1.42 (.78)
		Post-Emotion Induction		
NPC	12.00-32.00	16.40 (4.21)	2.38 (.43)	6.02 (.83)
MDD	0.00-31.00	16.77 (5.44)	.64 (.43)	2.84 (.83)
BPD	14.00-48.00	22.33 (9.63)	1.36 (.40)	.88 (.78)
		Post-Mirror Tracing		
NPC	12.00-31.00	15.70 (4.02)	2.74 (.43)	7.63 (.83)
MDD	0.00-28.00	16.57 (3.65)	1.63 (.43)	2.21 (.83)
BPD	13.00-52.00	20.34 (9.95)	1.83 (.40)	2.63 (.78)

Note: This table presents raw, non-transformed scores.

Table 7: Descriptive Statistics of Cardiac Pre-ejection Period

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC	22.00-133.96	50.68 (32.21)	2.16 (.49)	4.44 (.95)
MDD	22.00-136.76	47.35 (29.67)	2.16 (.49)	4.44 (.95)
BPD	24.00-106.68	40.85 (20.31)	2.31 (.52)	5.79 (1.01)
		Emotion Induction		
NPC	22.80-131.59	46.68 (28.83)	2.15 (.49)	4.35 (.95)
MDD	25.10-137.13	46.75 (28.58)	2.43 (.49)	5.31 (.95)
BPD	23.30-85.18	41.05 (17.56)	1.36 (.52)	1.26 (1.01)
		Post-Mirror Tracing		
NPC	22.98-136.82	51.03 (31.06)	1.78 (.49)	2.52 (.95)
MDD	25.00-130.71	47.82 (28.79)	2.05 (.49)	3.59 (.95)
BPD	22.30-115.76	43.88 (25.97)	1.78 (.52)	2.58 (1.01)

Note: This table presents raw, non-transformed scores.

Table 8: Descriptive Statistics of Skin Conductance Level

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC	0.00 – 20.00	17.12 (4.59)	2.31 (.45)	6.61 (0.87)
MDD	.71-20.00	14.56 (5.39)	-.98 (.45)	.15 (.87)
BPD	.68-20.00	13.45 (7.29)	-.71 (.45)	-1-.01 (.87)
		Emotion Induction		
NPC	.63-.20.00	18.82 (2.52)	-2.63 (.45)	7.49 (.87)
MDD	.68-.20.00	14.94 (5.65)	-1.09 (.45)	.29 (.87)
BPD	.68-20.00	13.41 (7.35)	-.72 (.45)	-.95 (.87)
		Post-Mirror Tracing		
NPC	.05-.20.00	18.78 (2.60)	-3.02 (.45)	10.28 (.87)
MDD	.00-.25	14.96 (5.75)	-1.30 (.45)	1.37 (.87)
BPD	-.67-20.00	13.61(7.24)	-.84 (.45)	-.72 (.87)

Note: This table presents raw, non-transformed scores.

Table 9: Descriptive Statistics of Respiratory Sinus Arrhythmia

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC	1.80-5.34	3.16 (0.93)	.85 (.43)	.54 (.85)
MDD	. 1.72-5.93	3.4 (1)	.32 (0.43)	.16 (.58)
BPD	. 1.80-7.54	3.29 (1.23)	1.98 (.46)	5.00 (.89)
		Emotion Induction		
NPC	1.87-4.46	3.06 (0.77)	0.3 (.43)	-.84 (.85)
MDD	1.63-2515.01	90.1 (466.38)	5.39 (.43)	29 (.85)
BPD	1.55-8.41	3.49 (1.46)	2.11 (.46)	4.96 (.89)
		Post-Mirror Tracing		
NPC	1.97-5.22	3.08 (0.83)	1.01 (.43)	.69 (.85)
MDD	.1.75-6.18	3.6 (1.07)	.24 (.43)	.03 (.85)
BPD	2.09-7.72	3.47 (0.25)	1.75 (.46)	3.79 (.89)

Note: This table presents raw, non-transformed scores.

Table 10: Descriptive Statistics of Zygomaticus Major Activation

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC	01-.05	.02 (.01)	1.95 (.47)	4.94 (.92)
MDD	.01-.04	.02 (.01)	1.70 (.45)	2.49 (.87)
BPD	.01-.07	.02 (.01)	1.54 (.44)	1.76 (.89)
		Emotion Induction		
NPC	.01-.04	.01 (.01)	1.44 (.47)	2.95 (.92)
MDD	.01-.06	.02 (.01)	2.21 (.45)	5.09 (.87)
BPD	.01-.07	.02 (.01)	1.86 (.44)	3.57 (.86)
		Post-Mirror Tracing		
NPC	.01-.02	.01 (.00)	.43 (.47)	-.78 (.92)
MDD	.01-.03	.02 (.01)	.93 (.45)	-.12 (.87)
BPD	.01-.08	.02 (.01)	3.54 (.44)	14.95 (.86)

Note: This table presents raw, non-transformed scores.

Table 11: Descriptive Statistics of Corrugator Supercilii Activation

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
		Baseline		
NPC	.01-.07	.03 (.02)	1.00 (.51)	1.08 (.99)
MDD	.01-.07	.03 (.02)	.86 (.47)	.02 (.92)
BPD	.00-.11	.05 (.03)	.96 (.55)	.41 (1.06)
		Emotion Induction		
NPC	.01-.07	.03 (.02)	.69 (.51)	.96 (.99)
MDD	.01-.10	.03 (.01)	.68 (.47)	-.59 (.92)
BPD	.00-.09	.04 (.02)	.45 (.55)	-.30 (1.06)
		Post-Mirror Tracing		
NPC	.01-.06	.02 (.01)	1.01 (.43)	.69 (.85)
MDD	.01-.06	.02 (.01)	1.23 (.47)	1.71 (.92)
BPD	.00-.05	.03 (.01)	.44 (.55)	-.15 (1.06)

Note: This table presents raw, non-transformed scores.

Table 12: Descriptive Statistics of Mirror Tracing Task

	Range	Mean (SD)	Skew (SE)	Kurtosis (SE)
NPC	21.87-420.00	203.92 (133.66)	.47 (.46)	-1.15 (.90)
MDD	34.80-348.57	153.48 (87.81)	.71(.43)	-.50 (.85)
BPD	15.60-420.00	156.51 (125.49)	.89 (.43)	-.07 (.85)

Note: This table presents raw, non-transformed scores.

Missing data.

Due to inconsistent responding (i.e., all responses were the same number), one participant's self-report data was excluded. Due to technical errors and noise or artefacts in the collection of physiological data, cardiac impedance data for 22 participants, skin conductance data for 9 participants, and electromyography data from 25 participants could not be included in the analyses. Further, programming errors led to the additional loss of 40 participants' concurrent self-reported emotion recordings. Finally, 16 participants' mirror tracing data were lost due to experimenter error. Tests of missing data bias reflected no significant correlations between the key variables and missing self-report data (*p*s = .02 - .98; 2 tests of gender had *p* values below .05), with a Bonferroni-corrected α = .007 (.05 / 7). There was evidence of missing data bias with respect to the physiological variables, however. Although the majority of the variables did not demonstrate bias (*p*s = .02 - .97; 3 tests had *p* values below .05), with a Bonferroni-corrected α = .003, RSA during and after the emotion induction was significantly associated with BPD diagnosis, *r*s = .30, *p*s = .003. The missing RSA data were eliminated due to noise and artefacts. Thus, it seems that participants with BPD were more likely to move during and after the emotion induction, creating more movement artefacts, perhaps as a result of emotional intensity.

Identification of covariates.

Reported use of suppression and dissociation as emotion regulation strategies were associated with baseline tendency to suppress on the ERQ, *r*s = .23-.39, *p*s = <.001 - .03. The correlation between PEP and weight was significant, $r = 18$, $p = .01$. In terms of SC level, both dissociation and cardiac medications demonstrated significant correlations; $r = -.21$, $p < .001$, and $r = -.23$, $p = .00$, respectively. Age, $r = .19$, $p < .001$, and sex, $r = -.18$, $p < .001$, were associated with SC responses. Height, $r = .15$, $p = .01$, and cardiac medications, $r = -.27$, $p < .001$, were associated with RSA. Age was also associated with EMG for zygomatic activity, $r = .24$, $p < .001$, whereas weight was correlated with EMG corrugator activity, $r = -.16$, $p = .02$. Dissociation emerged as a significant correlate of self-reported urges, $r = .59$, $p < .001$. In terms of the mirror tracing task, time to quit the task was associated with errors during the task, $r = .46$, $p < .001$. Gender was associated with endorsing undifferentiated emotions, $r = -.34$, $p = .01$. These variables were included as covariates in the relevant analyses, although models without covariates generally showed similar patterns of findings.[1]

Sample Composition

Results from independent *t* tests and MANOVAs suggested that participants were comparable across conditions in terms of demographic information and trait measures of emotion and emotion regulation (see Table 13). Participants in the Accept and Suppress conditions were not significantly different in terms of age, $t(80) = .67$, $p = .51$, the proportion of females, $\chi^2(1) = .03$, $p = .86$, the proportion of Caucasian participants. χ^2 (1) = .36, $p = .55$, and the proportion taking medications, χ^2 (1) = .31, $p = .58$ or cardiac medications, χ^2 (1) = .48, $p = .49$. There was no significant difference between conditions in terms of levels of experiential avoidance, $t(91) = 1.88$, $p = .06$, difficulties with emotion regulation, $F(6, 85) = 1.44$, $p = .21$, $\eta^2 = .09$, mindfulness, $t(91) = 1.72$, $p = .09$, alexithymia, $t(92) = 1.52$, $p = .13$, BPD symptoms, $t(83) = 1.66$, $p = .10$, or depressive symptoms, $t(83) = 1.04$, $p = .30$. In addition, the conditions were not significantly different in terms of average number of personality disorders, $t(98) = .64$, $p = .52$, anxiety disorders, $t(98) = .50$, $p = .52$, or substance use disorders, $t(98) = .50$, $p = .62$.

Table 13: Means and Standard Deviations of Individual Differences Across Conditions

Variable	All Participants	Accept	Suppress
Female	83%	82.35%	83.67%
Caucasian	49%	54.5%	60.98%
Taking psychotropic medication	27%	29.41%	24.49%
Taking cardiac medications	12%	9.80%	14.29%
	M (SD)	**M (SD)**	**M (SD)**
Age	31.13 (10.96)	31.91 (11.34)	30.28 (10.59)
Depressive symptoms (BDI)	16.48 (13.34)	17.93 (15.02)	14.93 (11.24)
BPD symptoms (PAI-BOR)	27.48 (15.34)	30.11 (15.66)	24.66 (14.66)
Alexithymia (TAS)	2.61 (.63)	2.72 (.62)	2.52 (.63)
Experiential Avoidance (AAQ)	4.19 (.98)	4.38 (1.02)	4.00 (.91)
Total Emotion Regulation Difficulties (DERS)	92.78 (27.72)	98.80 (27.63)	86.76 (26.77)
Expressive Suppression (ERQ)	3.49 (1.25)	4.49 (1.30)	4.58 (1.16)
Mindfulness (MAAS)		51.64 (15.24)	46.20 (15.20)

Note: AAQ = Acceptance and Action Questionnaire; ACS = Affect Control Scale; BDI = Beck Depression Inventory; DERS = Difficulties with Emotion Regulation Scale; ERQ = Emotion Regulation Questionnaire; MAAS = Mindfulness Attention Awareness Scale; PAI-BOR = Personality Assessment Inventory – Borderline Scale; TAS = Toronto Alexithymia Scale.

Participants across diagnostic groups were comparable on many of these variables as well (see Table 14). Participants across groups were not significantly different in terms of age, F (2, 79) = .50, p= .61, proportion of Caucasians, χ^2 (2) = .4.67, p = .10, or proportion of females, χ^2 (2) = 1.25, p = .54. As expected, there were group effects on number of Axis I and Axis II diagnoses, F(4, 194) = 21.02, p < .001. Although the BPD group had significantly more Axis II diagnoses than the MDD and NPC groups, ps < .001, the BPD and MDD groups did not differ significantly in the number of Axis I diagnoses, p = .09. Groups differed significantly in use of psychotropic medication, χ^2 (2) = 16.32, p < .001, but not in use of cardiac medication, χ^2 (2) = 2.75, p = .25.

Table 14: Diagnostic Composition Across Groups

Variable	NPC	MDD	BPD
Female	75.76%	76.67%	86.48%
Caucasian	46.67%	60.60%	48.65%
Taking psychotropic medication	0%	42.42%	35.14%
Taking cardiac medications	6.67%	9.09%	18.92%
Major Depressive Disorder	0%	100%	89.19%
Dysthymic Disorder	0%	9.10%	18.92%
Psychotic NOS	0%	6.06%	8.11%
Substance Use Disorder*	16.67%	36.36%	56.76%
Panic Disorder	0%	6.06%	21.62%
Social Phobia	0%	15.15%	16.22%
Specific Phobia	0%	21.21%	21.62%
Obsessive Compulsive Disorder	0%	0%	13.51%
Post-Traumatic Stress Disorder	0%	18.18%	35.14%
Generalized Anxiety Disorder	0%	9.09%	27.03%
Somatization Disorder	0%	0%	5.41%
Body Dysmorphic Disorder	0%	3.03%	13.51%
Anorexia Nervosa	0%	6.06%	2.70%
Bulimia Nervosa	0%	0%	5.41%
Binge Eating Disorder	0%	9.09%	5.41%
Antisocial Personality Disorder	0%	0%	10.81%
Avoidant Personality Disorder	0%	6.06%	13.51%
Histrionic Personality Disorder	0%	0%	0%
Narcissistic Personality Disorder	0%	0%	2.70%
Obsessive Compulsive Personality Disorder	0%	9.10%	24.32%
Paranoid Personality Disorder	0%	6.06%	27.03%
Schizoid Personality Disorder	0%	0%	2.70%
Schizotypal Personality Disorder	0%	0%	2.70%
	M (SD)	M (SD)	M (SD)
Age	29.58 (11.04)	32.55 (11.52)	31.11 (10.46)
Average Number Axis I Disorders	.23 (.50)	3.06 (2.97)	4.22 (2.19)
Average Number Axis II Disorders	0	.36 (.70)	1.89 (1.48)

Note: AAQ = Acceptance and Action Questionnaire; ACS = Affect Control Scale; BDI = Beck Depression Inventory; DERS = Difficulties with Emotion Regulation Scale; ERQ = Emotion Regulation Questionnaire; MAAS = Mindfulness Attention Awareness Scale; PAI-BOR = Personality Assessment Inventory – Borderline Scale; TAS = Toronto Alexithymia Scale. Substance use disorders comprise alcohol and substance abuse and dependence. Within the NPC group, these included only history of alcohol abuse.*

Manipulation Check

First, an EFA was conducted to examine the structure of the manipulation check items. Based on an examination of the scree plot and eigenvalues >1, the data suggested justification for retaining either four or five factors. I chose to use the five-factor model because there were fewer cross loadings across factors, and this model yielded more theoretically consistent factors. This model demonstrated good fit, $\chi^2 = 99.86$, $p = .02$. This EFA yielded five factors: (1) Reappraisal, (2) Emotion suppression, (3) Acceptance, (4) Expressive Suppression, and (5) Dissociation (see Table 15 for factor loadings). As described above, internal consistency was good for all factors, except for Dissociation, so this factor was not examined in subsequent analyses.

With these factors as DVs, the MANOVA revealed a significant effect of Condition, $F(4, 90) = 3.41$, $p =.01$, $\eta^2 = 13$, as predicted. Unexpectedly, participants in the Suppress condition did not endorse greater use of emotion suppression strategies overall, compared with the Accept condition, $F(1, 93) = .92$, $p =.34$, $\eta^2 = .01$. Further, the difference between conditions in reported acceptance strategies was non-significant, $F(1, 93) = 2.01$, $p =.16$, $\eta^2 = .02$. Participants in the Suppress condition did, however, report using more expressive suppression than those in the Accept condition, $F(1, 93) = 5.00$, $p =.03$, $\eta^2 = .05$. Surprisingly, participants in the Suppress condition also reported using significantly more reappraisal strategies, $F(1, 93) = 9.32$, $p <. 01$, $\eta^2 = .09$. There was also a significant effect of Group, $F(8, 182) = 2.39$, $p = .02$, $\eta^2 = .10$. Although pairwise comparisons were non-significant., there was some indication that the BPD participants reported more expressive suppression ($M = 1.19$, $SD = 1.02$) than the NPC group ($M = .81$, $SD = .82$), $p = .17$. There was no significant Group x Condition interaction, $F(8, 182) = 1.01$, $p = .43$.

In a MANCOVA with the suppression scale of the ERQ as a covariate, there was a significant effect of Condition, $F(4, 82) = 3.85$, $p = .01$, $\eta^2 = .16$. Participants in the Suppress condition reported using significantly more emotion suppression strategies, $F(1, 85) = 4.31$, $p = .04$, $\eta^2 = .05$, and expressive suppression, $F(1, 85) = 7.93$, $p = .01$, $\eta^2 = .09$, in comparison with the Accept condition. In addition, the participants in the Suppress condition reported using significantly more reappraisal strategies than the Accept condition, $F(1, 85) = 10.22$, $p < .01$, $\eta^2 = .11$. There were no significant differences between conditions in reported use of acceptance strategies, $F(1, 85) = 2.23$, $p = .14$, $\eta^2 = .03$. There was also a significant Group effect, $F(8, 166) = 2.44$, $p = .02$, $\eta^2 = .11$, but pairwise comparisons were non-significant; however, the NPC group reported using less expressive suppression compared with the MDD group, $p = .07$, and the BPD group, $p = .13$. There was no significant Group x Condition interaction, $F(8, 166) = .77$, $p = .63$.

Table 15: Factor Loadings of Manipulation Check Items

	Factor				
Item	**1**	**2**	**3**	**4**	**5**
Reappraisal					
When I was faced with a stressful situation, I made myself think about it in a way that helped me stay calm	**.65**	.15	.13	.10	.14
I controlled my emotions by changing the way I	**.74**	.05	-.04	.13	-.07

thought about the situation I was in.					
When I wanted to feel less negative emotion, I changed the way I was thinking about the situation.	**.97**	-.01	-.05	.05	-.18
Emotion Suppression					
Pushed my emotions away.	.02	**.85**	-.03	-.11	.07
Suppressed or bottled them up.	-.30	**.56**	.01	.21	-.28
Distracted myself with other activities.	.10	**.64**	.03	.06	-.02
+When I wanted to feel less negative emotion (such as sadness or anger), I changed what I was thinking about.	.28	**.50**	-.08	.18	.07
Acceptance					
Just noticed them (my emotions).	.00	.08	**.55**	.09	-.23
Observed them and let them come and go.	.21	-.08	**.67**	-.17	.02
*I didn't mind feeling uncomfortable.	.08	-.16	**.56**	.03	.31
*I just let myself experience whatever emotions came up.	-.23	.05	**.75**	.01	-.15
Expressive Suppression					
+I kept my emotions to myself.	.08	.19	.02	**.50**	.03
+I controlled my emotions by not expressing them.	.12	.00	.04	**.89**	.22
+When I felt negative emotions, I made sure not to express them.	.07	-.09	.02	**.69**	-.13
Dissociation					
Carried on with my activities.	.15	.09	.09	.00	**-.38**
Acted on them/acted on impulse.	-.02	-.09	.03	.02	**-.80**
I found myself on automatic pilot.	-.09	.12	.04	324	**-.37**

*Note: * signifies items adapted from the Responses to Emotions Questionnaire; + signifies items from the Emotion Regulation Questionnaire. This table presents raw, non-transformed scores.*

Aim 1: Examine the Effects of Emotion Suppression on Emotional Responses

To examine the effect of emotion regulation instructions on emotional reactivity, I used a GLMM approach with a random intercept. Fixed effects included Group (0 = NPC, 1 = MDD, 2 = BPD), Condition (0 = Accept, 1 = Suppress), Time 1 (coded 0 at baseline, and 1 at and after the breakpoint, defined as the emotion induction timepoint), Time 2 (coded 0 through the breakpoint, and 1 after the breakpoint), Group x Condition, Group x Time 1, Group x Time 2, Condition x Time 1, Condition x Time 2, Group x Condition x Time 1, Group x Condition x Time 2. The time breakpoint variables were included as covariates. Covariance matrices were chosen based on model information statistics (see Table 16). Findings using GLMM mirrored those using repeated measures ANOVAs (see Appendix C).

Table 16: Model Information Statistics

N = 99	Self-Reported Negative Emotions	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level1	634.63	616.63	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	626.07	610.07	26
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	622.52	614.52	22
	Diagonal covariance matrix, level 2			
N = 99	Self-Reported Positive Emotions	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level1	671.95	653.95	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	665.82	653.82	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	664.69	656.69	22
	Diagonal covariance matrix, level 2			
N = 80	Cardiac Pre-ejection Period	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	490.43	472.43	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	484.57	472.57	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	483.84	475.84	22
	Diagonal covariance matrix, level 2			
N = 91	Skin Conductance Level	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	198.70	180.70	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	282.69	270.69	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	293.18	285.18	22
	Diagonal covariance matrix, level 2			
N = 77	Skin Conductance Responses	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	567.00	549.00	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	561.36	549.36	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	577.12	569.12	22

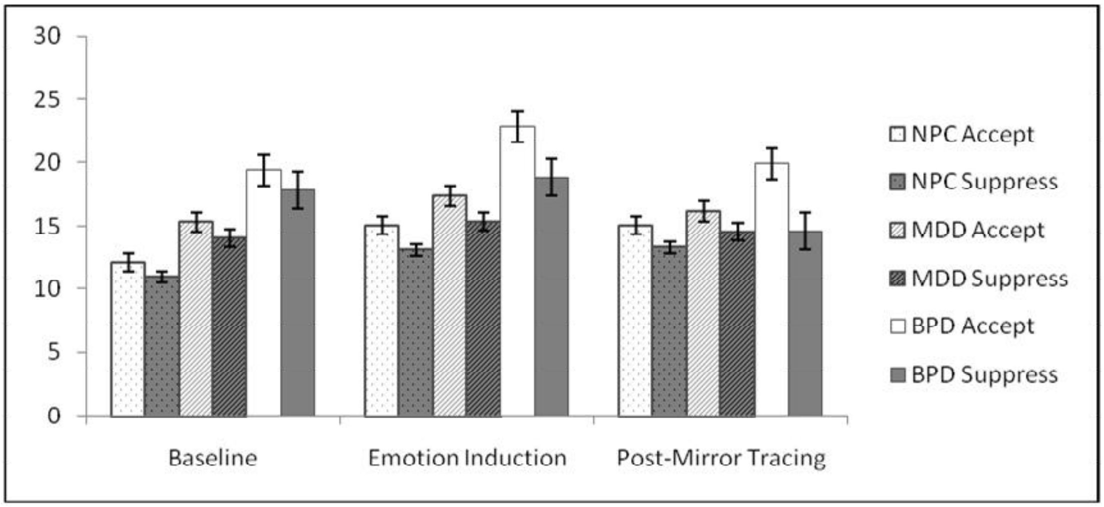
	Diagonal covariance matrix, level 2			

N = 91	Respiratory Sinus Arrhythmia	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	224.84	206.84	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	190.83	178.83	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	191.35	183.35	22
	Diagonal covariance matrix, level 2			
N = 71	Zygomaticus Major	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	473.29	455.29	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	468.60	456.60	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	503.16	495.16	22
	Diagonal covariance matrix, level 2			
N = 75	Corrugator Supercilii	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	449.63	431.63	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	446.85	434.85	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	465.06	457.06	22
	Diagonal covariance matrix, level 2			
N = 99	Urges for Maladaptive Behaviours	AIC	-2LL	Parameters
1	Unstructured covariance matrix, level 1	463.03	445.03	27
	Unstructured covariance matrix, level 2			
2	Diagonal covariance matrix, level 1	458.01	442.01	24
	Unstructured covariance matrix, level 2			
3	Autoregressive errors, homogeneous, level 1	453.21	445.21	22
	Diagonal covariance matrix, level 2			

Self-reported emotions.

This model was fit with an autoregressive covariance matrix at level 1, and a diagonal covariance matrix at level 2, (AIC = 622.52, -2RLL = 614.52; $N = 99$; $R^2_L = .56$) (see Figure 2). As expected, there was an effect of Group, $F(2, 120.83) = 10.05$, $p < .001$. Specifically, the BPD group reported greater negative emotions compared with the NPC group, $p = .00$, but not significantly more than the MDD group, $p = .15$. There was also the anticipated effect of Time 1, $F(1, 97.63) = 26.36$, $p < .001$, and Time 2, $F(1, 98.09) = 41.76$, $p < .001$, with greater negative emotions reportedly experienced during the emotion induction compared with baseline, $p < .001$, $d = .36$, and post-mirror tracing task, $p = .04$, $d = .21$, suggesting that the social rejection audio-recording elicited negative emotions, as intended. Also consistent with expectations, there was a Condition x Time 2 interaction, $F(1, 98.09) = 5.44$, $p = .02$, with the Accept condition reporting having experienced more negative emotions compared with the Suppress condition during the emotion induction, $p = .02$, $d = .59$, and after the mirror-tracing task, $p = .05$, $d = .46$. As hypothesized, there were significant Group x Time, $F(4, 182) = .87$, $p = .02$, and Group x Condition x Time 2 interactions, $F(6,93.43) = 5.03$, $p < .001$, such that participants in the Accept condition only reported significantly more negative emotions in comparison with the Suppress condition during the emotion induction within the BPD group, $p = .05$, $d = .63$. The effect of Condition was non-significant, $F(1, 120.83) = 1.70$, $p = .20$, suggesting that the instructions prior to the emotion induction accounted for the effects of Condition. There were no significant effects of Condition x Time 1, Group x Time 1, Group x Time 2, Group x Condition x Time 1, or Group x Condition x Time 2, ps = .15 - .90. Post-hoc power analyses indicated that power for these analyses ranged from .22 to .81 (Faul et al., 2007).

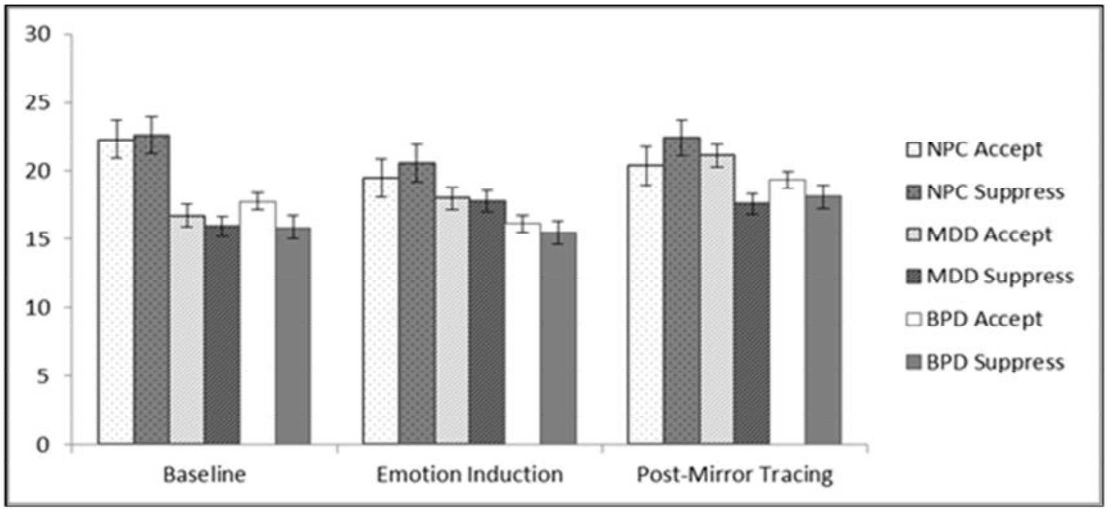
Figure 2: Self-reported negative emotions during laboratory session



To evaluate the effects of Group and Condition on self-reported positive emotions, a model was fit with a level 1 homogeneous autoregressive errors covariance matrix, and level two with a diagonal covariance matrix (AIC = 664.69, -2LL = 656.69; $N = 99$; $R^2_L = .29$) (see Figure 3). As expected, there was a significant effect of Group, $F(2, 122.94) = 4.59$, $p = .01$. Specifically, the BPD group reported fewer positive emotions overall, compared with the NPC group, $p < .001$, $d = .63$, although the MDD group was not significantly different from either the NPC or BPD groups, *p*s = .17 and .99, respectively. There was also an effect of Time 2, $F(1, 100.37) = 4.25$, $p = .04$, such that participants reported experiencing lower levels of positive emotions during the emotion induction, compared with after the emotion induction, $p = .03$, $d = .27$, further supporting the effectiveness of the social rejection audio-recording as an emotion induction. The effect of Time 1 was non-significant, $F(1, 106.22) = 2.52$, $p = .12$, as was the effect of Condition, $F(1, 122.94) = .47$, $p = .49$. There were no significant effects of Group x Condition, Condition x Time 1, Condition x Time 2, Group x Time 1, Group x Time 2, Group x Condition x Time 1, or Group x Condition x Time 2, *p*s = .12 - .99.

Post-hoc power analyses indicated that power for these analyses ranged from .22 to .81 (Faul et al., 2007).

Figure 3: Self-reported positive emotions during laboratory session

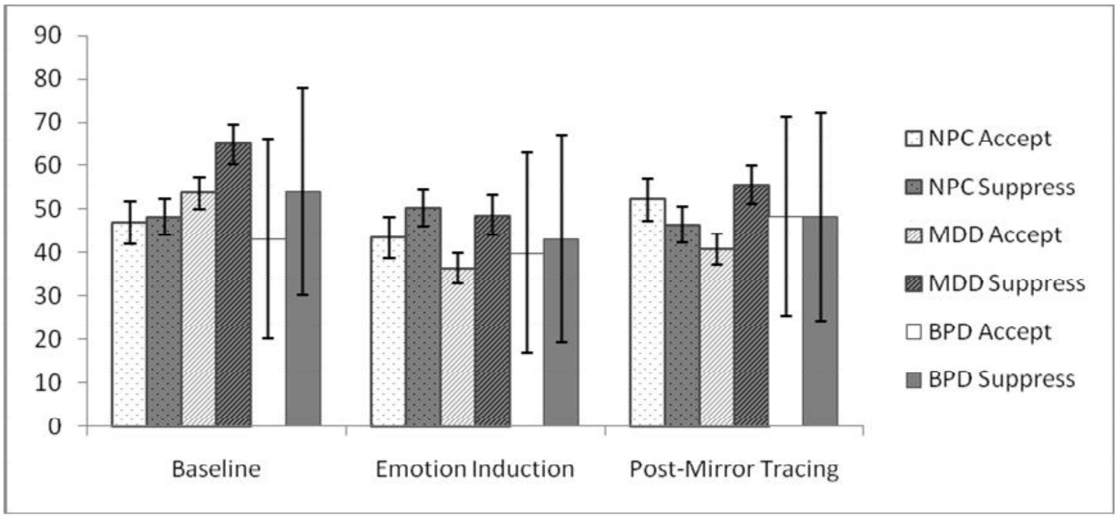


Cardiac pre-ejection period.

A model (AIC = 483.84, -2RLL = 475.84; N = 80; R^2_L = .24) with level 1 homogeneous autoregressive errors covariance matrix, and level two with a diagonal covariance matrix, was constructed to evaluate the effect of suppression versus acceptance on PEP, with weight included as a covariate (see Figure 4). There was a significant Group x Condition x Time 1 interaction, $F(2, 70.37) = 3.58$, $p = .03$. In contrast to the hypothesized shorter PEP among BPD participants and within the Suppress condition, comparisons revealed that the MDD group exhibited longer PEP (indicating heart rate deceleration) following the suppression instructions, compared with those MDD participants in the Accept condition, $p = .02$, $d = .96$. This pattern did not emerge in the BPD or NPC groups. There was no significant effect of Group, Condition, Time 1, Time 2, Group x Condition, Condition x Time 1, Condition x Time 2, Group x

Time 2, or Group x Condition x Time 2, *p*s = .07 - .78. Power for these analyses ranged from .11 to .58 (Faul et al., 2007).

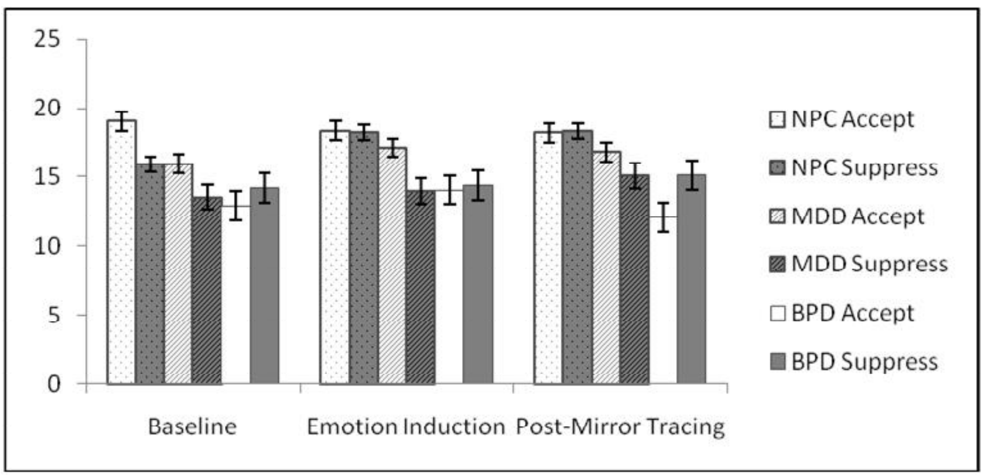
Figure 4: Cardiac pre-ejection period during laboratory procedures



Skin conductance.

The model (AIC = 198.70, -2RLL = 180.70; $N = 91$; $R^2_L = .97$) of SC level with unstructured covariance matrices for level 1 and level 2, with cardiac medications and height as covariates and dissociation as a time-varying covariate, revealed a significant effect of Group, $F(2, 80.34) = 5.25$, $p = .01$; the BPD group exhibited a lower SC level, compared with the NPC group, $p < .001$, $d = 2.44$ (see Figure 5). The BPD group was not significantly different from the MDD group, however, $p = .15$. In addition, there was a significant effect of Time 2, $F(1, 77.09) = 255.03$, $p < .001$, with lower levels of SC at baseline, compared with the other time points, suggesting greater arousal during and after the emotion induction. There was also a Group x Time 1 interaction, $F(2, 71.12) = 3.27$, $p = .04$, and a Group x Time 2 interaction, $F(2, 77.09) = 94.03$, $p < .001$, with the NPC group demonstrating a significantly different trajectory of skin conductance, compared with the other groups. Specifically, the NPC group exhibited an increase in SC from baseline to during the emotion induction, $p = .02$, $d = .62$, whereas there were no such differences between time points in other groups. Contrary to the hypothesized sympathetic arousal expected within the Suppress group, there were no effects of Condition, $F(1, 80.34) = .15$, $p = .70$, Condition x Time 1, $F(1, 71.13) = .29$, $p = .59$, or Condition x Time 2, $F(1, 77.09) = .26$, $p = .62$, There were also no effects of Time 1, Group x Condition, Group x Condition x Time 1, or Group x Condition x Time 2, *p*s = .24 - .96.

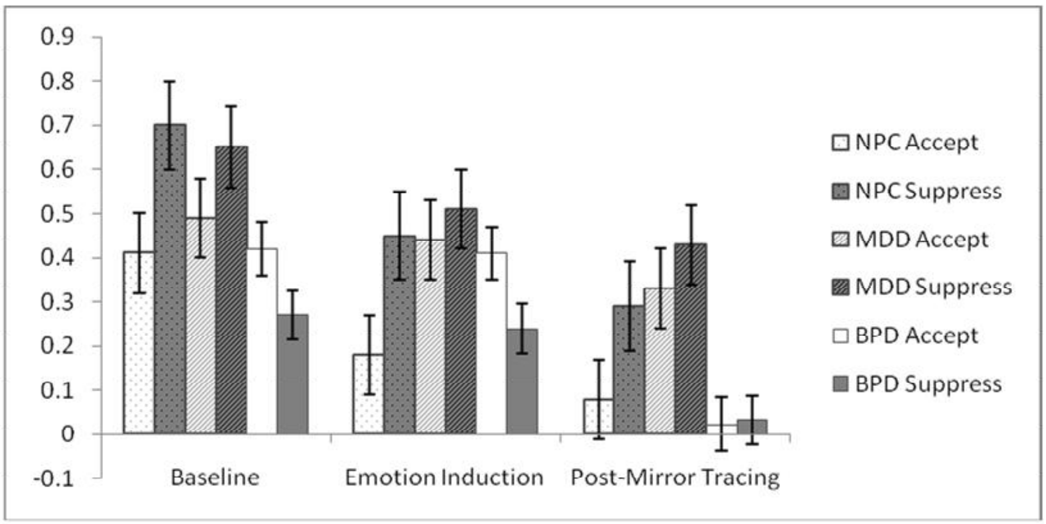
Figure 5: Skin conductance level during laboratory procedures



In terms of SC responses, a model (AIC = 561.36, -2RLL = 549.36; $N = 77$; $R^2_L = .73$) was constructed with unstructured covariance matrices for level 1 and level 2, and age and sex as covariates (see Figure 6). There was a significant effect of Time 2, $F(1, 110.59) = 14.80$, $p < .001$; comparisons were non-significant, but suggested that the average number of SC responses was lower after the emotion induction, compared with baseline or during the emotion induction. There were no significant effects of Group, Condition, Time 1, Group x Condition, Condition x Time 1, Condition x Time 2, Group x

Time 1, Group x Time 2, Group x Condition x Time 1, or Group x Condition x Time 2, *p*s = .14 - .62. Post-hoc, power for these analyses ranged from .17 to .92 (Faul et al., 2007).

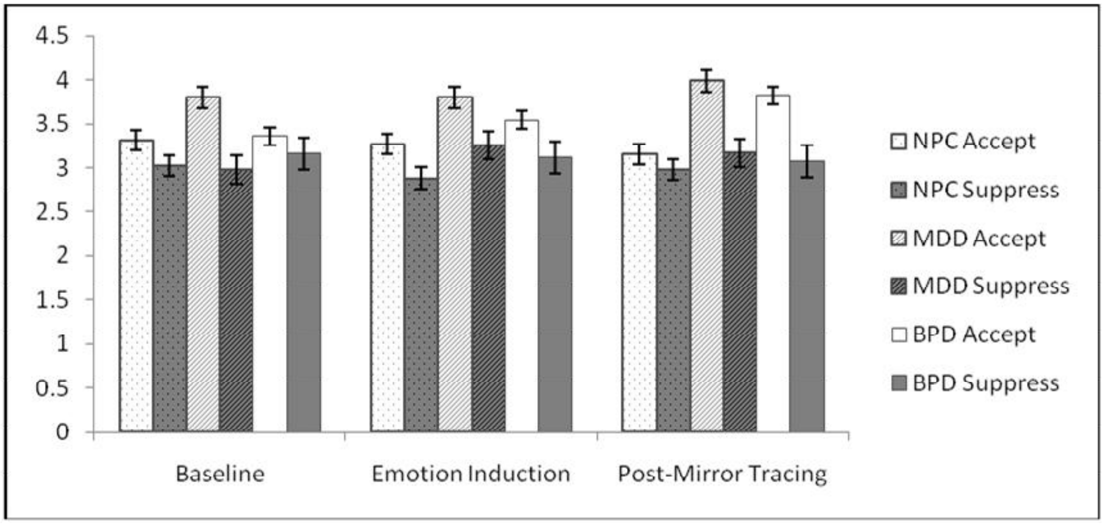
Figure 6: Skin conductance responses during laboratory procedures



Respiratory sinus arrhythmia.

The model constructed for evaluation of the effects of Group and Condition on RSA (AIC = 190.83, -2RLL = 178.83; $N = 91$; $R^2_L = .24$) had a level 1 diagonal covariance matrix, and level two with an unstructured covariance matrix, with height and cardiac medication as covariates (see Figure 7). There was the expected effect of Condition, $F(1, 85.38) = 8.66$, $p < .001$, such that participants in the Accept condition exhibited higher RSA overall, compared with the Suppress condition, $d = .24$. There were no significant effects of Group, Time 1, Time 2, Group x Condition, Condition x Time 1, Condition x Time 2, Group x Time 1, Group x Time 2, Group x Condition x Time 1, or Group x Condition x Time 2, *p*s = .16 - .93. Post-hoc, power for these analyses ranged from .12 to .71 (Faul et al., 2007).

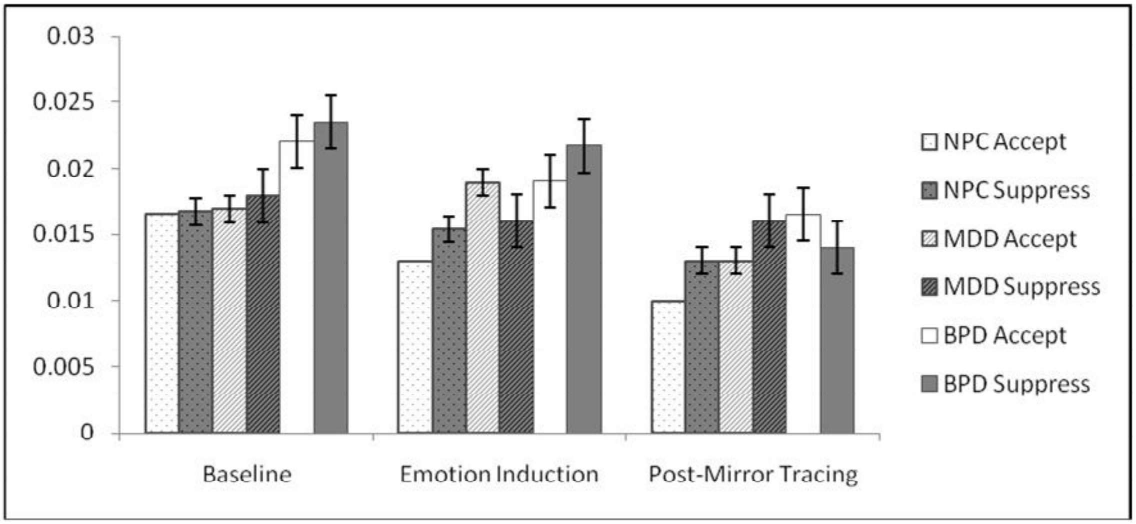
Figure 7: Respiratory sinus arrhythmia during laboratory session



Facial electromyography.

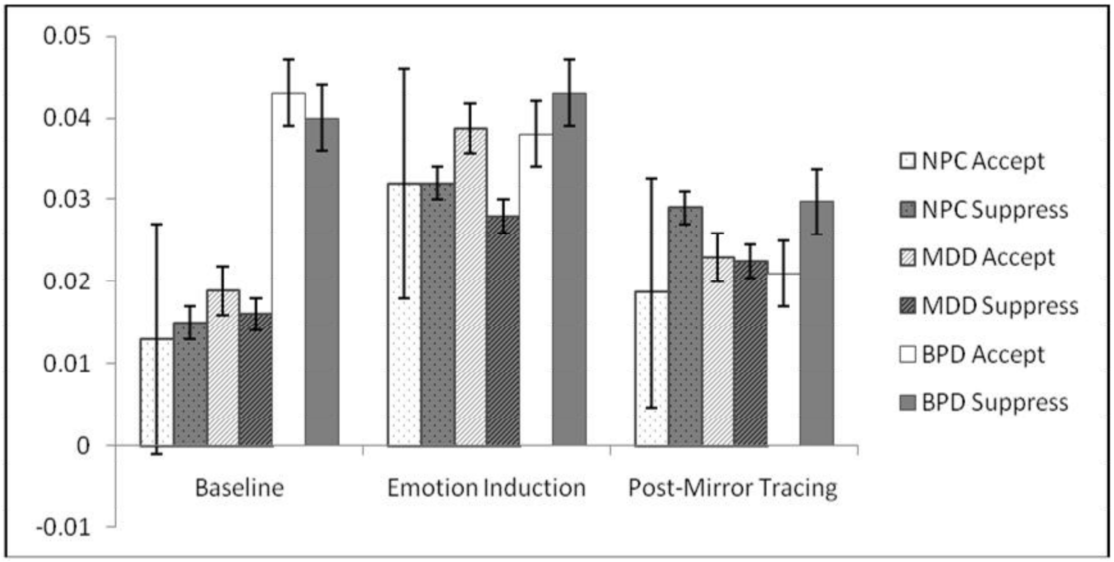
The model constructed for evaluation of the effects of Group and Condition on gross zygomatic activation (AIC = 468.60, -2RLL = 456.60; $N = 71$; $R^2_L = .63$), with a diagonal covariance matrix at level 1 and an unstructured covariance matrix at level 2 (see Figure 8), yielded a significant effect of Time 2, $F(1, 120.77) = 13.07$, $p < .001$, with decreased zygomatic activity after the mirror tracing task, compared with during the emotion induction or baseline, *p*s < .001 , *d*s = .46. There was also a significant Group x Condition x Time 2 interaction, $F(2, 120.76) = 3.99$, $p = .02$, suggesting that the effects of time only emerged in the MDD Accept group, and the BPD Suppress group, *p*s < .001, *d*s = .70 and .28, respectively. There were non-significant effects of Group, $F(2, 129.03) = 2.64$, $p = .08$, and Group x Time 1 interaction, $F(2, 117.47) = 2.58$, $p = .08$, such that greater zygomatic activation was evident within the BPD group during the emotion induction. There was no significant effect of Condition, $F(1, 129.01) = 1.61$, $p = .21$, suggesting that not all participants in the Suppress condition engaged in expressive suppression. Nor were there significant effects of Time 1, Group x Condition, Condition x Time 1, Condition x Time 2, Group x Time 2, or Group x Condition x Time 1, *p*s = .14 - .84.

Figure 8: Zygomaticus major during laboratory procedures



Corrugator activity was evaluated with a model fit with a diagonal covariance matrix at level 1, and an unstructured covariance matrix at level 2 (AIC = 446.85, -2RLL = 434.85; $N = 75$; $R^2_L = .88$), with weight as a covariate (see Figure 9). There was a significant effect of Time 2, $F(1, 69.17) = 68.06$, $p < .001$, such that levels of corrugator activity were significantly lower after the mirror tracing task, compared with during or at baseline, *p*s < .001, *d*s = .80 and .76, respectively . There were no significant effects of Group, Condition, Time 1, Group x Condition, Condition x Time 1, Condition x Time 2, Group x Time 1, Group x Time 2, Group x Condition x Time 1, or Group x Condition x Time 2, *p*s = .09 - .93. Overall, power to detect effects in these analyses ranged from .11 to .96 (Faul et al., 2007).

Figure 9: Corrugator supercilii during laboratory procedures



Support for Aim 1.

Taken together, these findings provide partial support for the Aim 1 hypotheses. First, these results indicated that the social rejection audio-recording was effective in eliciting negative emotions and reducing positive emotions. There was also evidence of higher SC responses and more corrugator activity, associated with negative emotions, during the emotion induction, compared with afterwards.

Support was mixed for Hypothesis 1a, that the Suppress condition would report more negative emotions and exhibit greater sympathetic arousal, compared with the Accept condition. Although the Suppress condition reported more negative emotions overall, the Suppress condition did not demonstrate heightened sympathetic arousal, compared with the Accept condition. Unexpectedly, among the MDD participants, the Suppress condition led to lower sympathetic activity, compared with the Accept condition. The Accept condition did, however, have higher levels of parasympathetic activity, as indexed by RSA.

Further, these results provide some support for Hypothesis 1b, that the BPD participants would report higher negative emotions, lower positive emotions, and exhibit greater sympathetic arousal overall, compared with the NPC and MDD groups. As expected, the BPD group reported more negative emotions overall compared with the NPC group, although not compared with the MDD group, and fewer positive emotions overall. There was no evidence of heightened sympathetic arousal among the BPD participants; rather, they exhibited lower levels of SC.

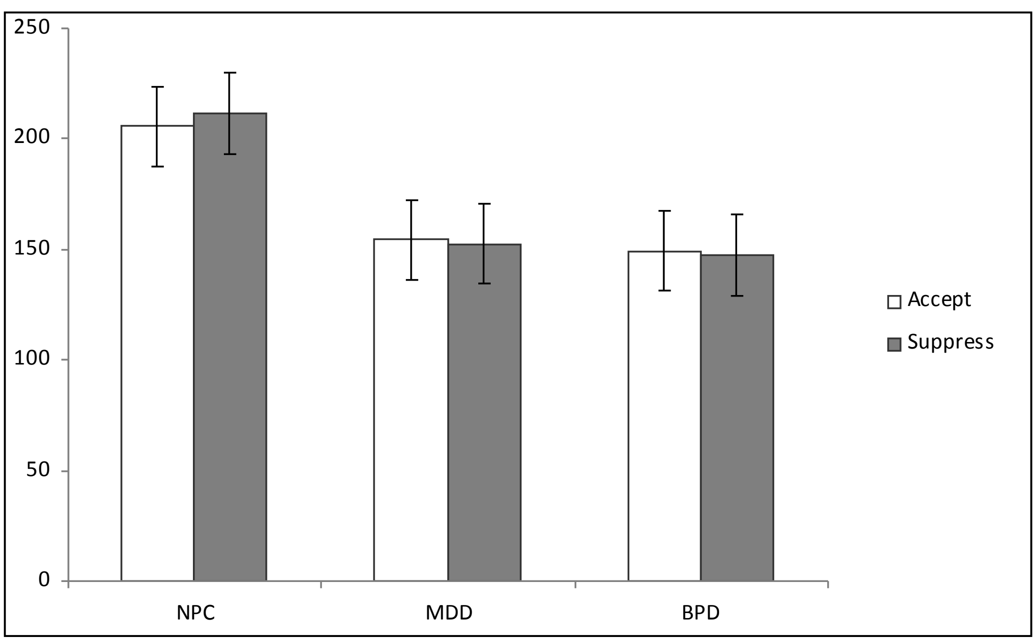
Finally, there was some support of Hypothesis 1c, that the effects of Condition would be heightened within the BPD group. Specifically, comparisons revealed that suppression resulted in more reported negative emotions than acceptance, but only within the BPD group. In addition, the data suggest that the BPD participants who were instructed to suppress their emotions exhibited heightened zygomatic activity during the emotion induction, in contrast with after the emotion induction, suggesting some expressive suppression.

Aim 2: Examine the Effects of Emotion Suppression on Distress Tolerance and Maladaptive Urges

Latency to quit the mirror tracing task. The Group x Condition ANCOVA, with errors during the task as a covariate (see Figure 10) yielded the hypothesized effect of Group, $F(2, 76) = 3.71$, $p = .03$, $\eta^2 = .09$. Subsequent pairwise comparisons indicated that, as expected, the BPD group had a significantly shorter latency to discontinue the task, on average (156.51 sec), compared with the NPC group (203.92 sec), $p = .04$. The difference between the MDD group and the NPC group, however, was non-significant, $p = .08$. Counter to expectations, there were no effects of Condition, $F(1, 76) = .34$, $p = .56$, or Group x Condition, $F(2, 76) = .08$, $p = .92$, ($\eta^2 = .0 - .04$). The Type II error was likely increased by the large variability in these scores (*M*s across groups 153.51 – 203.92; *SD*s 87.81 – 133.66), as power for this test fell below .10 (Faul et al., 2007).

The logistic regression model predicting participants quitting the mirror tracing task within 45 seconds, there was a significant effect of BPD, Exp(B) = .19 (95% CI = .04 - .78), Wald $Z = 5.27$, $p = .02$. Thus, not having diagnosis of BPD reduced the chances a participant would quit the task within 45 seconds by nearly 20%. When MDD was entered into the model, the model remained significant, $\chi^2 = 6.38$, $p = .04$; however, neither BPD, Exp(B) = .27 (95% CI = .05 - 1.46), nor MDD, Exp(B) = 2.44 (95% CI = .21 – 28.58), were significant predictors. When Condition, Exp(B) = 1.22 (95% CI = .30 – 4.92), was added to the model, the model was no longer significant, $\chi^2 = 6.45$, $p = .09$.

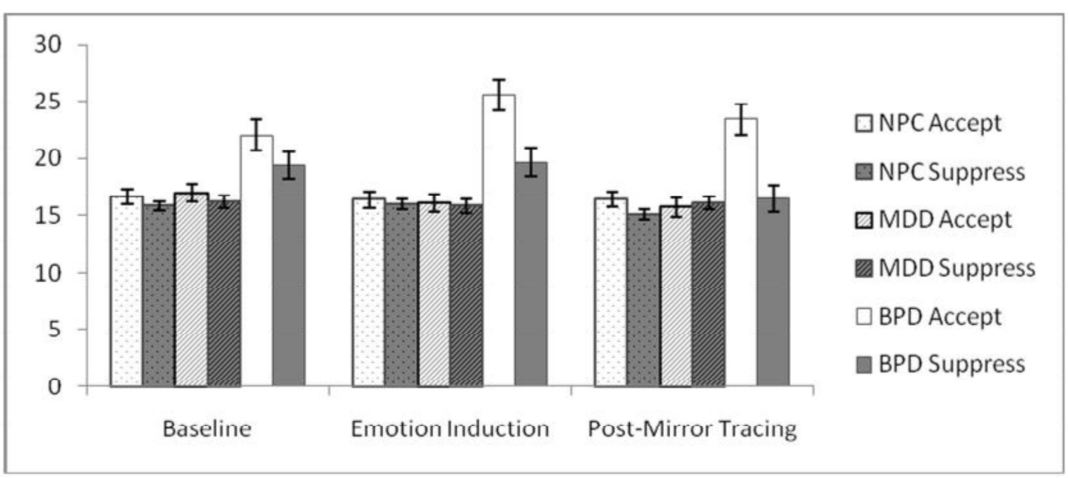
Figure 10: Latency to quit the mirror tracing task across conditions



Urges.

The model (AIC = 453.21, -2LL = 445.21; *N* = 99; R^2_L = .39) of total urges was constructed with a homogeneous autoregressive covariance matrix at level 1, and a diagonal covariance matrix at level 2 (see Figure 11). There was the expected effect of Group, $F(2, 145.81) = 6.71$, $p < .001$; the BPD group reported greater urges overall, compared with the NPC group, $p < .001$, and the MDD group, $p = .01$. Consistent with expectations, pairwise comparisons indicated that participants in Accept condition reported significantly higher urges than those in the Suppress condition within the BPD group, p =.02, but not within the NPC or MDD groups, *p*s = .67-.71. There was also an effect of Time 2, $F(1, 170.87) = 14.74$, $p < .001$, such that participants reported lower urges overall after the mirror tracing task, in comparison with directly following the emotion induction, $p < .001$. There were no significant effects of Condition, Time 1, Group x Condition, Condition x Time 1, Condition x Time 2, Group x Time 1, Group x Time 2, Group x Condition x Time 1, or Group x Condition x Time 2, *p*s = .26 - .85. Post-hoc, power for these analyses ranged from .11 to .76 (Faul et al., 2007).

Figure 11: Urges to engage in maladaptive behaviours across conditions



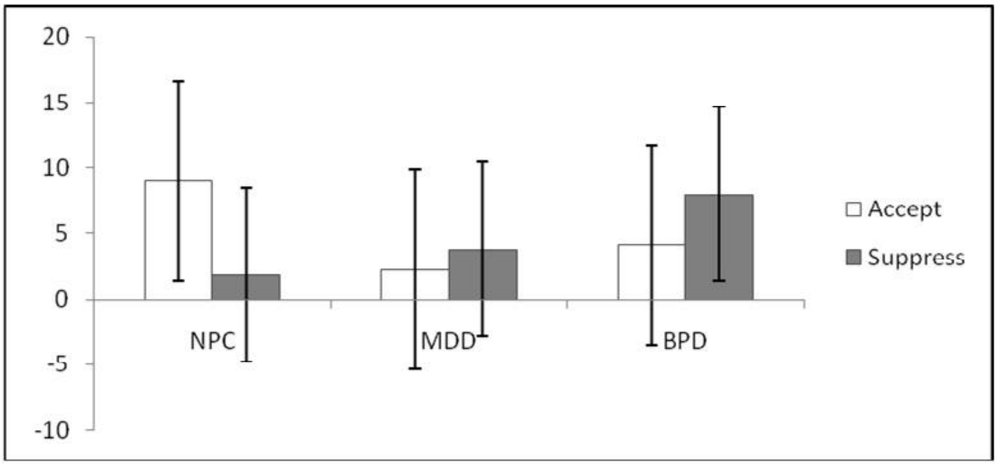
Support for Aim 2.

There was no support for Hypothesis 2a, that suppression would lead to shorter latencies to quit the mirror tracing task. The results did provide support for Hypothesis 2b; the BPD group generally ended the mirror tracing task earlier, compared with the NPC group. Further, there was evidence supporting Hypothesis 2c, as BPD participants reported more maladaptive urges overall, and BPD participants in the Accept condition reported more urges than those in the Suppress condition.

Aim 3: Examine the Effects of Emotion Suppression on Emotion Identification

A Group x Condition x Time repeated measures ANOVA ($N = 53$; participants who did not endorse any items were excluded listwise) was conducted with the number of nonspecific emotions endorsed as the DV, and with the total number of endorsements as a covariate (see Figure 12). As hypothesized, there was a significant effect of Condition, $F(1, 46) = 5.07$, ,$p = .03$, $\eta^2 = .10$, with participants in the Suppress condition making more endorsements of undifferentiated emotions, compared with the Accept condition. Pairwise comparisons revealed that those in the Suppress condition reported significantly more undifferentiated emotions, compared with the Accept condition, but only within the BPD group, $p = .02$. This was not the case within the MDD or NPC groups, *p*s = .16 and .94, respectively. These data provide support for Hypothesis 3, that the Suppress condition would report more non-specific emotions relative to the Accept condition, particularly within the BPD group. There were no significant effects of Time, $F(1, 46) = 1.93$, ,$p = .17$, $\eta^2 = .04$, Group, $F(2, 74.50) = 1.65$, ,$p = .20$, $\eta^2 = .07$, or Time x Group x Condition, $F(2, 46) = .30$, ,$p = .74$, $\eta^2 = .01$. There were no other significant interactions, *p*s = .17 - .24. The lack of responses and data loss resulted in reduced power for this analysis, with a maximum 1-β = .37 (Faul et al., 2007).

Figure 12: Undifferentiated emotions across conditions



Supplementary Analyses

Gender differences.

One of the benefits of including both males and females in the present study is the ability to examine whether gender may moderate the effects of the emotion regulation instructions. Therefore, the primary analyses were run with gender as an IV and interactions of other IVs with gender. These findings should be interpreted with caution, given the unequal sample sizes of males versus females.

In terms of self-reported negative emotions, gender did not emerge as a moderator of the effects of diagnosis or emotion regulation instructions. There were no effects of gender, and no significant interactions involving gender, *p*s .1-.9. With regard to self-reported positive emotions, however, there was an effect of Gender, $F(1, 133.05) = 7.40$, $p = .01$, such that men reported more positive emotions overall. There were no interactions with other IVs, however, *p*s = .18 - .61. The effect of Group remained significant, $F(2, 132.60) = 4.82$ $p = .01$, although the effect of Time 2 was no longer significant with the addition of this additional parameter, $F(1, 134.67) = 1.72$ $p = .19$. Yet, when the original model was run with males excluded, Time emerged again as a significant IV, $F(1, 83.16) = 4.6$, $p = .03$, suggesting that the addition of an additional parameter resulted in reduced power (1-β was less than or equal to .08) to detect small effects (Faul et al., 2007).

The findings suggested that gender did not have a significant effect on sympathetic responsivity, and did not moderate the effects of diagnostic group or emotion regulation on sympathetic responses. When examined within the GLMM for PEP, there was no significant effect of Gender, p =.67, nor were there any significant interactions with Gender, ps = .11 - .60. Similarly, there was no significant effect of Gender with regard to SC level, $p > .99$. There were no significant interactions with Gender, ps = .41 - .96. Further, there was no significant effect of Gender or interactions with Gender in terms of SC responses, ps = .08 - .87.

In terms of parasympathetic responses, however, gender emerged as a moderator of emotion regulation instructions. There remained an effect of Condition, $F(1, 80.92) = 7.40$, $p < .001$, but there was no effect of Group, Time, or Gender, ps = .11 - .69. There were significant interactions of Group x Time 1, $F(2, 80.71) = 3.86$, $p = .03$, Condition x Time 1, Condition x Gender, $F(1, 133.05) = 7.40$, $p = .01$, Condition x Gender x Time 1, $F(1, 80.61) = 5.62$, $p = .02$, and Group x Condition x Gender x Time 2, $F(1, 75.55) = 5.22$, $p = .03$. In particular, pairwise comparisons suggested that, although the Accept condition exhibited higher RSA compared with the Suppress condition within the BPD and MDD groups, this difference was only significant among males within the NPC group, p = .04, but not among females in the NPC group, p = .85. When the original model was run with just females, the pattern of findings remained the same as when males and females were included; there was a main effect of Condition, $F(1, 70.17) = 4.12$, $p = .046$.

Gender did not play a role in terms of electromyography activation. For instance, in terms of zygomatic activity, there was no effect of Gender, $p = .55$, and no significant interactions with Gender, ps = .45 - .91. There were no significant effects or interactions with Gender in terms of corrugator activity, ps = .07 - .89.

Although there was an effect of Gender on urges to engage in maladaptive behaviours, $F(1, 137.89) = 5.81$, $p = .02$, such that men reported more urges than women overall, the pairwise comparison was non-significant, $p = .17$. There were no significant interactions with Gender, ps = .34-.95. With latency to quit the mirror tracing task as a DV, there were no significant effects or interactions with Gender, ps = .45-.91.

Concurrent emotions.

In light of the association of suppression on identification of specific emotions such as anger, sadness, and fear in past research (Lane et al., 2000), as well as the findings of the present study, an examination of the effect of emotion regulation instructions on specific emotions reported was warranted. Further, studies suggest specific emotional reactivity in BPD, especially with regard to shame, hostility, sadness, and fear (Trull et al., 2008). Therefore, several exploratory analyses were undertaken. A set of Group x Condition x Time repeated measures ANOVAs ($N = 53$) were conducted, with the total number of emotions clicked for Shame, Hostility, Sadness, and Anxiety as DVs (see Figure 13).

In addition, Group x Condition ANOVAs ($N = 17$-26) were conducted, with first response time for clicking each of these emotions as the DV. Participants who did not click these emotions were excluded from analyses, resulting smaller sample sizes. Working power for these analyses was less than or equal to .28 (Faul et al., 2007).

In terms of total Shame endorsements, there was no effect of Group, $F(2, 47) = .33$, $p = .72$, $\eta^2 = .01$, Condition, $F(1, 47) = 1.15$, $p = .29$, $\eta^2 = .02$, Group x Condition, $F(2, 47) = 1.15$, $p = .33$, $\eta^2 = .05$, Time x Group, $F(2, 47) = .55$, $p = .58$, $\eta^2 = .02$, Time x Condition, $F(1, 47) = .35$, $p = .56$, $\eta^2 = .01$, or Time x Group x Condition ,$F(2, 47) = 1.62$, $p = .21$, $\eta^2 = .06$. There was an effect of Time, $F(1, 47) = 4.86$, $p = .03$, $\eta^2 = .09$, such that significantly more shame was reported during the emotion induction, in comparison with baseline.

In terms of time to the first identification of Shame, there were no effects of Group, $F(2, 20) = .37$, $p = .70$, $\eta^2 = .04$, Condition, $F(1, 20) = 2.07$, $p = .17$, $\eta^2 = .09$, or Group x Condition, $F(2, 20) = .36$, $p = .70$, $\eta^2 = .03$. Sample size for this analysis was $N = 26$.

With regard to the total Hostility endorsements, there was a non-significant Time x Group x Condition interaction,, $F(2, 47) = 2.97$, $p = .06$, $\eta^2 = .11$. Pairwise comparisons were non-significant, but suggested that there was a difference between Conditions in the BPD group, $p = .09$. There were no significant effects of Time, $F(1, 47) = 2.50$, $p = .12$, $\eta^2 = .05$, Group, $F(2, 47) = 1.12$, $p = .34$, $\eta^2 = .05$, Condition, $F(1, 47) = .03$, $p = .87$, $\eta^2 <$

.01, Group x Condition, $F(2, 47) = .99$, $p = .34$, $\eta^2 = .04$, Time x Group, $F(2, 47) = .26$, $p = .77$, $\eta^2 = .01$, Time x Condition, $F(1, 47) = 2.15$, $p = .15$, $\eta^2 = .04$,

In terms of time to the first identification of Hostility, there were no effects of Group, $F(2, 11) = .15$, $p = .86$, $\eta^2 = .03$, Condition, $F(1, 11) = .30$, $p = .60$, $\eta^2 = .03$, or Group x Condition, $F(2, 11) = 2.35$, $p = .14$, $\eta^2 = .30$. These analyses were severely limited by the sample size ($N = 17$).

In terms of total endorsements of Sadness, there was no effect of Time, $F(1, 47) = 2.41$, $p = .13$, $\eta^2 = .05$, Group, $F(2, 47) = .42$, $p = .66$, $\eta^2 = .02$, Condition, $F(1, 47) = .20$, $p = .64$, $\eta^2 = .00$ Group x Condition, $F(2, 47) = 1.43$, $p = .25$, $\eta^2 = .06$, Time x Group, $F(2, 47) = 1.52$, $p = .23$, $\eta^2 = .00$, Time x Condition, $F(1, 47) = ..17$, $p = .68$, $\eta^2 = .00$, or Time x Group x Condition, $F(2, 47) = 1.47$, $p = .24$, $\eta^2 = .06$.

In terms of time to the first identification of Sadness, there were no effects of Group, $F(2, 23) = .25$, $p = .78$, $\eta^2 = .02$, Condition, $F(1, 23) = 2.45$, $p = .13$, $\eta^2 = .10$, or Group x Condition, $F(2, 23) = .74$, $p = .49$, $\eta^2 = .06$ ($N = 29$).

With regard to the number of endorsements of Anxiety, there was no effect of Group, $F(2, 47) = 1.53$, $p = .23$, $\eta^2 = .06$, Group x Condition, $F(2, 47) = 2.39$, $p = .10$, $\eta^2 = .09$, Time x Group, $F(2, 47) = 1.46$, $p = .24$, $\eta^2 = .06$, or Time x Group x Condition ,$F(2, 47) = 1.12$, $p = .33$, $\eta^2 = .05$. There was a significant effect of Time, $F(1, 47) = 9.31$, $p = .00$, $\eta^2 = .17$, with more anxiety endorsed during the emotion induction, in comparison with baseline. There was also an effect of Condition, $F(1, 47) = 4.09$, $p = .049$, $\eta^2 = .08$, with more endorsements of anxiety in the Suppress condition ($M = 2.89$, $SE = .69$) compared with the Accept condition ($M = 1.06$, $SE = .60$). In addition, there was a significant Time x Condition interaction, $F(1, 47) = 4.12$, $p = .048$, $\eta^2 = .08$, suggesting that this difference between conditions only arose during the emotion induction.

With regard to time to the first identification of Anxiety, there was a significant effect of Condition, $F(1, 16) = 9.70$, $p = .01$, $\eta^2 = .38$, such that the participants in the Accept condition identified Anxiety sooner (M = 105,058.60 msec, SE = 20, 373.73 msec), compared with the Suppress condition (M = 200,809.75 msec, SE = 23,019.58 msec). There was no effect of Group, $F(2, 16) = 2.92$, $p = .08$, $\eta^2 = .27$, although the BPD group tended to endorse Anxiety earlier (M = 113,397.60 seconds, SE = 2,637.24) than the NPC group (M = 205,766.40 seconds, SE = 28,889.34), $p = .09$. There was no significant interaction of Group x Condition, $F(2, 16) = .88$, $p = .43$, $\eta^2 = .10$. These analyses were also constrained by the sample size (N = 22).

Figure 13: Specific emotions across conditions

Discussion

This study examined the real-time effects of instruction in emotion regulation strategies for people with BPD. The findings provided partial support for the hypotheses proposed, and suggest that persons with BPD demonstrate a unique pattern of effects of emotion regulation strategies. Overall, findings suggested that individuals with BPD may experience negative effects when asked to accept their emotions in response to an interpersonal stressor, at least in the short-term.

Of particular interest, the emotion regulation instructions had unintended consequences. In particular, participants who received acceptance instructions did not report using significantly more acceptance strategies during the emotion induction. Further, the participants who were instructed to engage in emotion suppression did not report greater use of emotion suppression strategies. Rather, participants in the suppression condition reported greater use of expressive suppression, in comparison with the acceptance condition. In addition, consistent with past research (Dunn et al., 2009), participants who received suppression instructions reported using more reappraisal strategies than those in the acceptance condition. When baseline tendencies to engage in suppression were taken into account, however, a difference between conditions emerged, suggesting that individuals who generally suppress their emotions struggle with using more acceptance-based strategies. Therefore, the effects of suppression in the present study may be attributable to expressive suppression and reappraisal. Alternatively, the instructions may have influenced participants' attitudes toward their emotions. For instance, both emotion suppression (e.g., Feldner et al., 2003) and fear of emotions (Salters-Pedneault et al., 2007) have been linked with emotional and physiological reactivity.

These findings pose the question of what emotion suppression actually entails. In the present study, several emotion regulation measures were combined to adequately assess strategies used during the laboratory procedures, providing an especially comprehensive manipulation check. In contrast, past research has typically used short, general measures to assess compliance (e.g., Campbell-Sills et al., 2006; Dunn et al., 2009), which do not always differentiate between expressive and emotion suppression, with items such as “I tried to hold back or suppress my emotional reactions.” The factors extracted in the present study, however, suggest that expressive suppression represents a distinct set of strategies from emotion suppression. Taken together, both past (e.g., Dunn et al., 2009) and present findings suggest that participants may use expressive suppression, distraction, and reappraisal when asked to suppress their emotions, which may have been obscured by the lack of granularity in compliance measures. The tendency to rely on expressive suppression when instructed to suppress emotions may account for the similar patterns of effects found between these different types of suppression (e.g., Gross & Levenson, 1997; Levitt et al., 2004). Thus, emotion suppression may consist of a number of behaviourally distinct strategies which share functional similarities in terms of emotional avoidance.

The emotion regulation instructions had several notable impacts in the present study. In particular, participants who were told to suppress their emotions tended to report fewer negative emotions, compared with participants who were instructed to accept their emotions. These findings also underscore some disadvantages associated with suppression. Consistent with expectations, participants in the suppression condition were more likely to report nonspecific emotions. These results are consistent with findings that suppression may be linked with difficulties identifying specific emotions (e.g., Lane et al., 2000). Despite the tendency for participants to report more negative emotions overall in the acceptance condition, the concurrent emotion reporting revealed that participants in the suppression condition were significantly more likely to endorse anxiety, in comparison with the acceptance group. This finding may be attributable to anxiety being endorsed as a general, less specific emotion. Alternatively, increased anxiety among participants who were suppressing their emotions may be linked with the increased fear of experiencing emotions often associated with suppression (Salters-Pedneault et al., 2007; Yen et al., 2002). Of particular interest, although suppression led to more endorsements of anxiety, the initial report of anxiety was delayed within this condition, compared with participants in the acceptance condition.

The two emotion regulation strategies also differentially influenced physiological reactivity. Acceptance led to higher levels of RSA, suggesting greater parasympathetic influence and regulation of negative emotions (Grossman & Taylor, 2007). This is consistent with research suggesting that meditative practice is associated with an overall increase in RSA (e.g., Delgado et al., 2010). Interestingly, this increase in RSA following acceptance instructions was not evident among the females in the NPC group, although the males exhibited higher RSA. This finding may reflect differences in emotion regulation tendencies between genders. If females tend to use acceptance more often than males at baseline, the acceptance instructions would have less of an impact on RSA. It is difficult to draw clear conclusions on the basis of this study, however, due to the small sample size of males. Suppression also led to longer cardiac pre-ejection periods in the present study, suggesting a decrease in sympathetic arousal, counter to existing research (e.g., Gross & Levenson 1997); however, this difference only occurred among depressed participants, and may be due to the dysphoria experienced by this group, as some research points to decreased cardiovascular responses due to sadness (e.g., Kreibig, Wilhelm, Roth, & Gross, 2007).

There was some evidence that suppression had unique impacts on emotional responsivity in BPD. Specifically, the BPD participants may generally be more likely to experience distress when using acceptance-based emotional approaches. Although instructed suppression resulted in fewer reported negative emotions than instructed acceptance generally, comparisons revealed that the difference was only significant within the BPD group. Further, evidence suggests that the BPD participants who were instructed to suppress their emotions exhibited heightened zygomatic activity , indicative of more positive facial expressions, during the emotion induction, in contrast with after the emotion induction, suggesting some expressive suppression. In addition, the suppression instructions resulted in decreased physiological arousal in the MDD group, and lower self-reported negative emotional state among the BPD group. Thus, the emotion regulation instructions had a differential impact on each diagnostic group.

Furthermore, the emotion regulation instructions affected the level of urges to engage in maladaptive coping behaviours, such as substance use and non-suicidal self-injury, among the participants with BPD. Although the BPD participants generally reported higher urges, there was some indication that BPD participants in the acceptance condition reported greater urges than BPD participants in the suppression condition. This finding replicates previous findings from ecological momentary assessment research among undergraduates high and low in BPD features (Chapman et al., 2009).

In terms of distress tolerance, however, the BPD group did not exhibit any differential responding based on emotion regulation instructions. Although the BPD group was more likely to terminate the mirror tracing task earlier, consistent with prior research (Gratz et al., 2006), there was no effect of emotion regulation instructions on task termination.

Together, these findings demonstrate both advantageous and disadvantageous consequences of instructed suppression. In terms of subjective emotional experience and reported urges to engage in maladaptive behaviours, the evidence from this study is in line with the adaptive suppression hypothesis (e.g., Dunn et al., 2009) and runs counter to the model of finite self-control resources (Muraven et al., 1997). On the other hand, although BPD participants who were instructed to use emotion suppression rather than acceptance reported fewer urges to engage in problem behaviours, there is no evidence that they had less capacity to regulate these urges. The lack of any effects of suppression on the behavioural measure of distress tolerance suggests that suppression did not yield any behavioural consequences during the laboratory procedures. Despite reporting fewer negative emotions overall, suppression seemed to lead to more, albeit delayed, reports of anxiety. Moreover, participants who engaged in suppression were more likely to endorse undifferentiated emotions, which could lead to more difficulties managing emotions in the long-term, however, given the effectiveness of specific emotional labels in reducing emotional arousal (Lieberman et al., 2007).

The psychophysiological findings also suggest some discordance across measures of arousal among persons with BPD. The BPD group exhibited greater zygomatic activation during the procedures, which has been associated with positively valenced affect in past research (e.g., Cacioppo et al., 2008), in contrast with the higher levels of negative emotions reported by the BPD group. These findings point to a possible discordance between the facial display and subjective experiences among individuals with BPD. These results are in accordance with findings that BPD is linked with more "mixed" facial expressions (Staebler et al., 2011), and the discordant patterns of physiological and subjective arousal often seen among persons with BPD (Rosenthal et al., 2008). Thus, facial expressions of people with BPD may be difficult for others to interpret, potentially contributing to miscommunication of emotions and interpersonal conflict. The BPD participants did not demonstrate a different pattern of parasympathetic activity when compared with NPCs and those with MDD, contrary to past research (e.g., Austin et al., 2007). This finding may be due to the difference in analytic strategies, in that Austin and colleagues examined RSA over the course of the emotion induction, whereas the analyses used in the present study contrasted overall levels of RSA during the emotion induction with baseline levels. Consistent with studies which have found hypoarousal among BPD samples (e.g., Herpertz et al., 2000), the BPD group exhibited a lower level of skin conductance overall. These results stand in contrast to past research from our laboratory suggesting that undergraduates with high levels of BPD features exhibit a larger number of skin conductance responses in response to the social rejection induction compared with low-BPD controls (Dixon-Gordon et al., 2011).

The pattern of discrepancies in findings across these and other studies suggest a unique combination of hypoarousal with a heightened likelihood of physiological reactivity to emotional stimuli among those with BPD or significant BPD features. That is, generally studies examining physiological reactivity to negative emotional stimuli, in contrast to neutral stimuli, report higher levels among participants with BPD (e.g., Dixon-Gordon et al., 2011; Ebner-Priemer et al., 2005). In these studies, reactivity was conceptualized as change from baseline activity, in terms of SC or startle response, respectively. On the other hand, studies examining average, absolute levels of arousal (such as heart rate) tend to observe hypoarousal among persons with BPD and hypoarousal of phasic responses overall across negative and neutral stimuli, (e.g., Herpertz et al., 1999; 2000), as was the case with the findings on overall SC level in the present study. Taken together, these findings suggest that future research could clarify the physiological reactivity of persons with BPD by examining phasic reactivity in response to negative stimuli, such as startle response or skin conductance response, alongside measures of tonic arousal, such as skin conductance level, in comparison to reactivity to neutral stimuli.

Limitations, Implications, and Future Directions

Several limitations of the present study warrant consideration. First, participants generally did not report having complied with the emotion regulation instructions, complicating the interpretation of these data. Despite this reported lack of adherence to the regulation instructions, strong effects of condition emerged in self-reported and physiological indices of emotional responsivity. As discussed above, it is possible that the greater use of expressive suppression and reappraisal in response to suppression instructions yielded these effects. It is also possible that the instructions had other unexpected effects, such as changing participants' attitudes towards their emotions. Finally, it may be that emotion suppression consists of cognitive control strategies in conjunction with emotion suppression. The mechanism by which the instructions affected participants remains an unanswered question.

Second, despite efforts to standardize data collection, large proportions of data were lost or eliminated due to artefacts. This reduced *N* resulted in lower power for analyses than expected, likely contributing to some non-significant findings. Third, participants were not excluded based on medication or substance use, and use of medication was strongly related to several outcome measures. At the same time, the pattern of findings did not change substantially depending on whether medication status was included as a covariate in analyses. Along the same lines, the inclusion of males in the sample permitted some examination of sex as a potential moderator. Although there were not sufficient males within our sample for a rigorous assessment, gender did not affect the overall pattern of results. These broad inclusionary criteria represent a strength of the study, and allows for greater generalization of these findings to clinical settings, but also present an impediment to drawing specific conclusions about the physiological data.

This research has taken steps to clarify the effects of emotion regulation methods on behaviours that are associated with considerable financial burden to the mental health system. For instance, the present research suggests that acceptance-based strategies may lead to greater levels of distress and physiological arousal in the short-term. In the context of the accumulating research on suppression, these findings suggest that suppression may be useful in tolerating acute stress in the short-term. This seems to be particularly true for individuals suffering from BPD. These findings have substantive implications for treatment. Currently, an empirically-supported treatment for BPD (Linehan, 1993) strongly emphasizes acceptance of emotions, and cautions against persistent use of emotion suppression. Therefore, given that the findings of this study underscore the utility of instructed emotion suppression in BPD, this would provide important information to be integrated into existing treatments. Another clinically relevant finding involves the responses to the emotion regulation instructions. The instructions were presented along with rationale, much in the same way that skills are presented within therapeutic contexts. Participants often did not adhere to these instructions, however, calling into question the degree of compliance we can expect in response to therapeutic interventions.

These findings also suggest several avenues for future research. For instance, the finding that participants generally did not comply with the emotion regulation instructions raises concerns with the existing emotion regulation laboratory research. In particular, future emotion regulation studies should include more comprehensive manipulation compliance measures, to provide a clearer understanding of what participants actually do in response to instructions. Further, the inconsistent effects of instructed emotion regulation across different domains in the present study, such that the instructions yielded self-reported and physiological but not behavioural effects, underscore the need for future multi-method assessment. Also, the field could benefit from a clearer, more behaviourally specific definition of emotion suppression. In addition, this study examined the circumscribed effects of emotion regulation strategies in the laboratory. The long-term consequences of continued use of these strategies, however, remain unknown. Future research should incorporate a follow-up period, to assess the effects of continued use of these strategies. In addition, this research revealed that suppression instructions can actually increase the experience of anxiety, which is likely why acceptance-based approaches are so helpful for people struggling with anxiety (e.g., Hayes et al., 1999). Future research should continue to examine the effects of suppression and other emotion regulation strategies on specific emotion identification, as well as latency to identify specific emotions. Current findings suggest that suppression may obfuscate social communication of emotions among persons with BPD, affecting both latency to identify emotions and facial expressivity of emotions. Thus, future studies should examine the role of suppression in interpersonal conflicts among people with BPD.

Collectively, this study represents an innovative approach to the examination of emotion regulation in BPD. Through the use of multi-method assessment and ecologically meaningful emotion inductions, the present study paints a more nuanced picture of the role of suppression in BPD. The present findings underscore the usefulness of suppression in some contexts among persons with BPD. In particular, these findings suggest that, contrary to clinical lore, individuals with BPD may actually derive more advantages from suppression, in comparison with other clinical groups. It is important to note that these advantages may merely be of a short-term nature, and further research is required to examine the longer term effects of these emotion regulation strategies. The information gathered in this study has important implications for research on ways to help people improve their ability to manage emotions, and may provide important information on how to develop or improve psychological treatments. With hope, these findings will translate into clinical settings, to reduce suffering among people who struggle with emotion dysregulation.

Footnotes

[1] Models without covariates demonstrated similar patterns of findings as those with covariates.

Aim 1 examined without covariates

Cardiac pre-ejection period.

A model (AIC = 493.24, -2RLL = 485.24) was constructed without a covariate. As in the original model, there was a significant Group x Condition x Time 1 interaction, $F(2, 71.40) = 3.72$, $p = .03$, such that the MDD group exhibited longer PEP in the Suppress condition, compared with those MDD participants in the Accept condition, whereas this pattern did not emerge in the BPD or NPC groups. There were no significant effect of Group, $F(2, 96.88) = .45$, $p = .64$, Condition, $F(1, 96.93) = 1.03$, $p = .31$, Time 1, $F(1, 71.54) = .09$, $p = .77$, Time 2, $F(1, 78.39) = 1.24$, $p = .27$, Group x Condition, $F(2, 96.88) = .10$, $p = .91$, Condition x Time 1, $F(1, 71.54) = .84$, $p = .36$, Condition x Time 2, $F(1, 78.39) = 3.44$, $p = .07$, Group x Time 1, $F(2, 71.40) = .28$, $p = .76$, Group x Time 2, $F(2, 78.12) = .73$, $p = .49$, or Group x Condition x Time 2, $F(2, 78.12) = .73$, $p = .48$.

Skin conductance.

A model of SC level (AIC = 220.94, -2RLL = 202.94) without height, medications, or dissociation as covariates replicated this pattern of findings. There were significant effects of Group, $F(2, 87.09) = 5.74$, $p = .01$, Time 2, $F(1, 128.67) = 403.87$, p

= .00, Group x Time 1, $F(2, 77.88) = 3.23$, $p = .045$, and Group x Time 2, $F(2, 148.24) = 148.24$, $p = .00$. There were no significant effects of Condition, $F(1, 87.09) = .07$, $p = .80$, Time 1, $F(1, 77.89) = 1.78$, $p = .19$, Group x Condition, $F(2, 87.09) = .94$, $p = .40$, Condition x Time 1, $F(1, 77.89) = .27$, $p = .60$, Condition x Time 2, $F(1, 128.67) = .87$, $p = .35$, Group x Condition x Time 1, $F(2, 77.88) = 1.35$, $p = .27$, and Group x Condition x Time 2, $F(2, 128.68) = .82$, $p = .44$.

Without age or sex as covariates, the model of SC responses (AIC = 676.59, -2RLL = 658.59) revealed an effect of Time 2, $F(2, 83.85) = 9.00$, $p = .00$. There were no significant effects of Group, $F(2, 86.07) = 1.48$, $p =.24$, Condition, $F(1, 86.07) = 1.20$, $p = .28$, Time 1, $F(1, 85.06) = .02$, $p = .88$, Group x Condition, $F(2, 86.07) = 1.36$, $p = .26$, Condition x Time 1, $F(1, 85.06) = .45$, $p = .50$, Condition x Time 2, $F(1, 83.85) = .95$, $p = .33$, Group x Condition x Time 1, $F(2, 85.06) = .13$, $p = .88$, or Group x Condition x Time 2, $F(2, 83.84) = .52$, $p = .60$.

Respiratory sinus arrhythmia.

A model with no covariates (AIC = 194.18, -2RLL = 182.18) revealed n effect of Condition, $F(1, 86.40) = 7.74$, $p = .01$. There were no significant effects of Group, $F(2, 86.41) = .40$, $p = .67$, Time 1, $F(1, 87.48) = 1.80$, $p = .18$, Time 2, $F(1, 83.57) = .00$, $p = .97$, Group x Condition, $F(2, 86.41) = .63$, $p = .53$, Condition x Time 1, $F(1, 87.48) = .36$, $p = .55$, Condition x Time 2, $F(1, 83.57) = .70$, $p = .41$, Group x Time 1, $F(2, 87.48) = 1.78$, $p = .18$, Group x Time 2, $F(2, 83.54) = .12$, $p = .89$, Group x Condition x Time 1, $F(2, 87.48) = 1.17$, $p = .32$, and Group x Condition x Time 2, $F(2, 83.54) = 1.24$, $p = .30$.

Facial electromyography.

A model examining zygomatic activity without covariates (AIC = 589.72, -2RLL = 577.72) revealed a similar set of findings. There were significant effects of Time 2, $F(1, 83.27) = 21.15$, $p = .00$, and Group, $F(2, 85.56) = 4.37$, $p = .02$, and non-significant interactions of Group x Time 1, $F(2, 80.49) = 2.62$, $p = .08$, and Group x Condition x Time 2, $F(2, 83.26) = 2.84$, $p = .06$. There were no significant effects of Condition, $F(1, 85.56) = .01$, $p = .95$, Time 1, $F(1, 80.50) = .42$, $p = .52$, Group x Condition, $F(2, 85.56) = .10$, $p = .90$, Condition x Time 1, $F(1, 80.50) = .06$, $p = .81$, Condition x Time 2, $F(1, 83.27) = .21$, $p = .65$, Group x Time 2, $F(2, 83.26) = 2.21$, $p = .12$, and Group x Condition x Time 1, $F(2, 50.49) = .42$, $p = .66$.

A model examining corrugator activity without covariates (AIC = 446.85, -2RLL = 434.85) reflected a similar set of findings. There was a significant effect of Time 2, $F(1, 69.17) = 68.06$, $p = .00$. There were no significant effects of Group, $F(2, 111.88) = 1.81$, $p = .17$, Condition, $F(1, 111.96) = .20$, $p = .65$, Time 1, $F(1, 54.86) = .45$, $p = .50$, Group x Condition, $F(2, 111.88) = .32$, $p = .72$, Condition x Time 1, $F(1, 54.86) = .01$, $p = .93$, Condition x Time 2, $F(1, 69.17) = 2.99$, $p = .09$, Group x Time 2, $F(2, 69.04) = 1.66$, $p = .20$, Group x Condition x Time 1, $F(2, 54.85) = 1.54$, $p = .22$, and Group x Condition x Time 2, $F(2, 69.04) = .25$, $p = .78$.

Aim 2 examined without covariates

Latency to quit the mirror tracing task.

The Group x Condition ANOVA yielded no effect of Group, $F(2, 77) = 2.09$, $p = .13$, Condition, $F(1, 77) = .00$, $p = .99$, or Group x Condition, $F(2, 77) = .01$, $p = .99$, (η^2 .0 - .05). Means suggest a tendency for the BPD and MDD groups to discontinue faster, on average (156.51 msec and 153.48 msec, respectively), compared with the NPC group (203.92 msec). The Type II error was likely increased by the large variability in these scores (*M*s across groups 153.51 – 203.92; *SD*s 87.81 – 133.66).

Urges.

In a model (AIC = 453.95, -2RLL = 445.95) without dissociation as a covariate, the pattern of findings remained the same. There were effects of Group, $F(2, 146.33) = 6.74$, $p = .00$ and Time 2, $F(1, 171.59) = 14.82$, $p = .00$. There were no significant effects of Condition, $F(1, 146.36) = 1.24$, $p = .27$, Time 1, $F(1, 172.72) = 1.29$, $p = .26$, Group x Condition, $F(2, 146.33) = .22$, $p = .81$, Condition x Time 1, $F(1, 172.72) = 1.17$, $p = .28$, Condition x Time 2, $F(1, 171.59) = .05$, $p = .82$, Group x Time 1, $F(2, 172.69) = .44$, $p = .65$, Group x Time 2, $F(2, 172.69) = .44$, $p = .65$, Group x Condition x Time 1, $F(2, 172.69) = 1.08$, $p = .34$, and Group x Condition x Time 2, $F(2, 171.61) = .23$, $p = .79$.

Appendices

Appendix A

Social Rejection Script (adapted from Robins et al., 1984)

Narrator: Please listen to this taped message very carefully. You will hear a description of a series of events, and you are to imagine that these things are happening to you. In order to help your imagination, please close your eyes, become relaxed and pay attention only to this tape. Try to imagine what you hear as vividly as you can. Form a mental picture of what is described, trying to include as much detail as you can. Try to get involved in what you hear, and experience how you might feel if this were really happening to you. Imagine yourself in this situation.

You have been in town for only a short time, and you have found it a difficult transition in many ways. In particular, you have been trying to meet people, make new friends, and this has been difficult. Fortunately, you have made a few friends, and particularly important, you have been seeing a guy who you like very much, and at this point, you feel very committed to him. However, last night, he didn't call when he was supposed to. So after a couple of hours, you called him. You were surprised to hear another girl answer. You felt startled and confused about what to say, and so you hung up. You wondered who this could be, and what she was doing there so late in the evening. Now today, walking to an appointment, you see your boyfriend walking with another girl. They are ahead of you, with their backs to you, and they do not notice you. Could this be the girl who picked up the phone last night? Did they even spend the night together? As they turn the corner, he puts his arm around her. Your worst suspicion seems confirmed. You feel utterly rejected.

After your appointment, you decide to go to a coffee shop to get something to drink, and hopefully, meet some of your friends to talk to, to take your mind off this. You order and sit at an empty booth. The booths have high partitions between them. As you sit down, you immediately recognize the voices of the people in an adjoining booth. They are two friends of yours, and you are about to go around and join them when you notice that they seem to be talking about you, so you sit and listen. This is what you overhear:

Male: Did you see what she was wearing at that party?

Female: Yeah. Unbelievable!

Male: I couldn't believe it either. She looked so out of place. Everyone must have noticed.

Female: If I'd come like that, I'd have died.

Male: She certainly looked pretty dumb.

Female: And she made such a fool of herself with those silly comments! Very unaware and close-minded!

Male: Yeah. Did you see everyone's reactions to what she was saying? I know she's argumentative over a lot of things. Sometimes she can be pretty reasonable, but you get her on to some things…

Female: Watch out!

Male: Yeah, and she just keeps on going! I don't know. I think it makes her look pretty bad. People just don't want to talk to her when she's being like that.

Female: It's really a pity because in some ways she's really nice. But I'm afraid she's going to lose friends this way.

Male: Yeah. Did you see her boyfriend today with that other girl? I bet she doesn't know about that. Maybe we should tell her what's happening.

Female: Yeah maybe we should. I saw them together last night too. I can certainly see why he'd want to see someone else, but still, it's a pretty bad Rum thing to do behind her back. I really feel sorry for her.

Narrator: Now please try to remember the events described on this tape, and spend a minute going over them in your mind's eye. Remember your situation at school, the telephone call to your boyfriend, the walk down the street, the overheard conversation. Keep your eyes closed, and imagine these events until you're asked to stop.

Appendix B

Emotion Regulation Instructions

Instructions for the acceptance condition.

I am going to spend some time now discussing a way that you can approach the coming task, and your negative emotions in general. I would like you to listen as I describe this to you, and consider whether this fits with your experience.

What I would like to suggest to you is that the very thing we try to do when we are experiencing negative emotions, try to control our negative emotions, is actually what makes us feel worse.

Frequently people wish to avoid negative emotions. If there is any way to turn the negative emotions off, or lessen it (such as by avoiding situations or distracting ourselves), we will usually try to do this. On one level this makes sense…of course we don't like to experience negative emotions, it's uncomfortable and frightening, why wouldn't we want to turn it off or get rid of it?

Well, the problem is, direct attempts to control our internal experience (things like thoughts and feelings), don't usually work for very long, if they work at all. We can tell ourselves to "stop thinking about this," but often times it's not as easy as it might seem. When you start to feel negative emotions, you might have thoughts like "Oh no, I don't want to feel like this...this is unbearable...I have to stop feeling this way...maybe if I try to focus on something else..." But research has shown us, and you probably know from your own experience, that the more you try to stop yourself from thinking about things, the more likely these thoughts are to come up and really affect you. The more you try to hold back your thoughts and feelings, the stronger they come.

Have you ever tried really hard to fall asleep, only to discover that you just can't? The more pressure you put on yourself to sleep, the harder it gets, until sleeping becomes almost impossible. Well, it works the same way with negative emotions. The harder you try to control them, the stronger they feel.

Now, this issue of control is an interesting one. You might wonder, what does this mean, are you saying that I don't have control over my life? Well, no, that's not what I'm suggesting at all. To the contrary, we know that all of us have control over our own behaviour, and in most cases, controlling your behaviour means having control in your life. Think of some of the accomplishments you have achieved in your life… educational, career, and physical accomplishments. Now think about how you achieved these goals. Probably through hard work, right? Usually good things happen to us when we work hard, and exercise discipline, training, and control. So, we clearly have control over our own behaviour, and this control is what makes us successful in every day life.

However, it doesn't quite work this way in the internal realm, the realm of thoughts and feelings. Remember what I said earlier about efforts to get rid of negative thoughts and feelings? While we may certainly have control over our own behaviour, and this may help us to accomplish our goals, we often do not have direct control over our own thoughts and feelings. And trying to apply these same control rules to our thoughts and feelings can really backfire.

Consider this: You suddenly start feeling negative emotions, the first thing you do is try to control the negative emotions, try to get rid of them. But, like I said, this just makes the feelings stronger and more frequent. So then, because you tried to control your negative emotions, and failed in your effort, you feel even worse, like you've personally failed in some way, or like you are out of control. This leads to a vicious cycle of trying even harder to control your thoughts and feelings until you are left feeling overwhelmed and helpless.

There is a saying that goes along with this, "if you're not willing to have it, you've got it." That is, if you are not willing to experience negative emotions, you're stuck with them. The harder you try to make the negative feelings go away, the more they stay. Have you noticed this? It isn't that you aren't trying hard enough. You're probably trying <u>very hard</u> to control your negative emotions. Instead, it's that the harder you try to push those feelings away, the stronger they come on.

The thing is, it is part of human experience that we will feel negative emotions at times. Where this process goes awry, is when we get in our own way, by forcefully trying to make the emotions go away. Even worse, sometimes our sense of happiness becomes dependent on our ability to control these things, and then when we find that we can't, we end up feeling worse and worse. You see, it is really your effort to push your negative emotions away that is the enemy, not the negative emotions themselves.

So, now I will offer you an alternative to this struggle with control. You might be wondering, "If I can't control my thoughts and feelings, does that mean that I have to give up? That I will not be able to do the things in life that I want to do?" No, this is not the case. In fact, as I mentioned before, the good news is that we actually can control a number of things in our life, because we can control our behaviour.

I would like to suggest that what you do right now is change your focus a bit. It's like you are in this massive tug of war with a monster---your negative emotions. In between you and the monster is a pit and so far as you can see it is bottomless. If you lose and fall into this pit you will be destroyed. So, you pull and pull, but the harder you pull, the harder the monster pulls (just like the harder you try to control your negative emotions, the more negative emotions you feel). So you keep pulling, and it seems like you just keep edging closer and closer to the pit. The hardest thing to see here is that your job is not to win the tug of war. (slowly) Your job is just to drop the rope. Give up the internal struggle, and let the symptoms of negative emotions just be. Let yourself feel whatever you feel, and quit fighting with your emotions. Now I'm going to give you a minute to think about that. (pause a few extra seconds). What I am suggesting is that you allow yourself to feel whatever emotions come up for you. Stop trying to control your negative emotions, just let them be.

There is a kid's game that illustrates the point I am trying to make. It is the Chinese Finger Trap. It's a tube of woven straw that you pick up, and insert each of your index fingers into the ends. Then, once your fingers are in, you try to pull them out, but they get stuck. As you try to yank them out, the straw catches and tightens. The harder you pull, the smaller the tube gets and the tighter the grasp on your fingers. In fact, the only way to escape this trap is to push your fingers in, which widens the tube, and then you can slide your fingers out.

So, how does this trap relate to the issue of mental control, and the upcoming task? You see, attempting to reduce and control essentially uncontrollable symptoms, like those you might experience, while seemingly logical and understandable, only creates more symptoms. Just like the finger trap, the harder you pull, the more the trap tightens, resulting in more pain and discomfort. In contrast, leaning into the symptoms, like pushing your fingers in, is the only way out of the trap. The harder you try <u>not</u> to feel negative emotions, the more negative emotions you feel, so why not give up the struggle against your negative emotions? Drop the rope in the internal tug of war, accept your feelings, and see what happens. (pause)

If what I have said so far makes some sense to you, you might be thinking now that giving up control is a way to manage your negative emotions. So you think, “since trying to control my thoughts and feelings only makes negative emotions worse, giving up the struggle will definitely makes things better for me, and ultimately make the negative emotions go away.” But, that is not what I am getting at. If you try and lean into your experience in the hope that it will make you less feel less negative, that is just another sneaky form of control. It looks like you have given up control, but you are still trying to win the battle over your negative emotions. Instead, I am suggesting that being willing to experience your thoughts and feelings, good and bad, can free you up to focus on what really matters in your life. If you are willing to feel happy, sad, anxious, unsure, joyful and any other emotions that come up for you, you can chose the activities that you want to participate in, so that you ultimately choose your directions in life, instead of letting your fear of negative thoughts and feelings make those choices for you. In the end, you will have more control over your life if you stop trying to control your negative emotions, and let yourself live life according to what is important to you.

In a few minutes we are going to begin the exercise that I mentioned earlier. During this task I would like you to pay attention to your feelings. You may experience a range of emotions; negative emotions, excitement, relaxation … I’d like you to try to experience them all fully, and not try to make any of them go away. Instead of trying actively to control them or push them away, I’d like you to try to lean into them, embrace them, and give up the struggle. Remember, the harder you try to, "Not feel negative emotions," the more negative emotions you will feel. Instead of battling with your negative emotions, try to take a step back from the struggle, drop the rope, and see what happens.

Instructions for the suppression condition.

I am going to spend some time now discussing a way that you can approach the coming task, and your negative emotions in general. I would like you to listen as I describe this to you, and consider whether this fits with your experience.

What I would like to suggest to you is that when you really put your mind to it, you can control most things in your life, including your thoughts, feelings, and behaviours.

Think about how much control you have over yourself everyday. Have you ever woken up in the morning, and not really felt like getting out of bed? You might've had a struggle with yourself, bargaining for a few extra minutes, but eventually, you talk yourself into getting into the shower, because you know you have somewhere to be. Even though you don't feel like it, you do it, because you know it's important. You exercise control over your behaviour every day. It's all about mind over matter. And it is the same way with your thoughts and feelings. Without thinking about it, you probably exercise control over your mind and your behaviour throughout most of your life.

And it makes sense that you do. If you didn't, your thoughts and feelings would be all over the place. Think about some of the most popular phrases that parents use with their kids, "don't cry, it's okay…don't be scared…be brave…" On some level we have all learned, and we all believe, that it is important for us to be in control of our minds at all times. When we have scary thoughts, we tell ourselves to be brave, when we feel sad about things, we call a friend so that we can cheer up, when we are angry with our bosses at work, we try to stifle our anger so that we do not explode, and when we worry about things, we do whatever we can to reassure ourselves that everything is really okay. This is an important part of survival. Think about what would happen if you just let your emotions rule your life! We can't always indulge in our own emotions, and let them make decisions for us, instead we have to control our thoughts and feelings, so that we can live our lives to the fullest.

Think of some of the accomplishments you have achieved in your life… educational accomplishments, career accomplishments, and physical accomplishments. Now think about how you achieved these goals. Probably through hard work, right? By exercising discipline, training, and control. You see, it is really very important that you always attempt to be in control, otherwise you probably wouldn't get very much done in your life.

The rules that apply to controlling your behaviour in order to achieve your goals, well these rules also apply to your thoughts and feelings. Have you ever had a personal problem, and made a big effort to not let it affect your performance in work or school? Even though you feel really upset inside, you can somehow manage to push it away long enough to perform well. Well, it's the same thing with all negative emotions. When you are feeling negative emotions, but you know you have to do something, you can push the feelings away in order to accomplish the task. That's what I am going to encourage you to do today. Try not to feel negative emotions, try not to think negative thoughts, try to just get through the task with as little negative emotion as possible. That's the goal.

Think about the people you might see on TV walking over hot coals or lying on a bed of nails. It's not that the coals don't feel hot, or that the nails aren't sharp, it's that these people have a lot of control over their emotional reactions, and are able to tolerate the pain, because they tell themselves not to feel it. By willfully trying to reduce the pain, these people can successfully endure experiences that other people cannot tolerate. It's all about control here, if they let their emotions run wild, they would never be able to complete the task. Instead, they exercise a great degree of control over their feelings and behaviours, and they are able to do it! The same thing applies to you. If you try very hard to willfully reduce your negative emotions, you will have an easier time with it. Don't let your negative emotions control you, you control your negative emotions.

If you are thinking to yourself right now that this sounds much easier than it actually is, you are probably right. It may be your instinct to try to make your negative emotions go away when they come up, but it is by no means an easy thing to do. It takes a lot of concentration and effort. I would like to suggest to you though, that it really is a successful strategy, and that it is really important that you master it. If it is difficult for you to do, perhaps you need to try a little harder? I am not suggesting any particular way for you to reduce your negative emotions, but just suggesting that if you try hard enough to get rid of them, you will likely succeed.

The thing is, it is part of human experience that we will feel anxious or sad, or uncomfortable at times. Where this process goes awry, is when we let it get in our way, by letting it get out of control. Instead of letting your negative emotions be the master of you, you need to be the master of your negative emotions. It's like I said before, mind over matter.

I'd like to give you one final example of how we really can control our own emotions. Have you ever heard of biofeedback? Well, biofeedback is a treatment method that teaches people how to increase their awareness of physical changes, and to exercise control over their own physical reactions. This treatment uses monitoring instruments to "feed back" information about bodily processes of which we are normally unaware. By watching the monitoring device during biofeedback, people can learn to adjust their thinking and other mental processes in order to control bodily functions that most people think of as involuntary, like blood pressure and heart rate. Basically, biofeedback is a training technique that teaches people to improve their own health and performance by exercising control over their body through the use of their minds. Research on this technique suggests that there is a very strong connection between our minds and our bodies, and that we can actually use mental control to modify our physiological responses (like heart rate). What this tells us, is that if you try very hard to control your negative emotions, it is likely that you will be able to, because increased mental control likely leads to increased physical control (like control over uncomfortable physical sensations). So, what we can learn from biofeedback, and apply to the upcoming exercise, is that if you try very hard to reduce your negative emotions, it is likely that you will be able to change them, and your physical reactions to the task as well.

Consider this: it's like you are in this massive tug of war with a monster---your negative emotions. In between you and the monster is a pit and so far as you can see it is bottomless. If you lose and fall into this pit you will be destroyed. So, you need to pull and pull, and pull your hardest, because the harder you pull, the more likely you are to win. Another way of saying this is, the harder you try to make your negative emotions go away, the more likely you are to reduce the uncomfortable symptoms.

I am not suggesting that if you use these strategies in your life that you will never experience pain or discomfort, but that, rather than just giving into the negative emotions, and accepting them, if you actually pay attention to them and try actively to make them go away, you will experience less negative emotion in the end. If you make an effort to really battle the negative emotions that come up for you and win the fight against these feelings, you can begin to focus on what really matters in your life. Once you get rid of the negative thoughts and feelings, you will be able to choose the activities that you want to participate in, so that you ultimately choose your directions in life, instead of letting your negative thoughts and feelings make those choices for you. As I said before, think mind over matter…you can master these feelings and make them go away.

In a few minutes we are going to begin the task that I mentioned earlier. During this task I would like you to pay attention to your feelings, and actively try to control them by pushing them away. You may experience a range of emotions; anxiety, excitement, relaxation … I'd like you to try to stay in control of your emotions throughout the task. Remember, the harder you try to, "Not feel negative emotions," the less negative emotion you will feel, and the better you will do.

Appendix C

Analyses: using Repeated Measures ANOVA

Aim 1 examined using ANOVAs.

Self-reported emotions.

In a Time (3: baseline, emotion induction, recovery) x Group (3: NPC, MDD, BPD) x Condition (2: Accept, Suppress) repeated measures ANOVA, with Bonferroni adjustments to subsequent pairwise comparisons for familywise error, there was a main effect of Time, $F(2, 90) = 12.65$, $p = .00$, $\eta^2 = .22$, with the higher endorsements of experiencing negative emotions during the emotion induction, compared with baseline, $p = .00$, and recovery, $p = .01$. There was also an effect of Group $F(2, 91) = 5.66$, $p = .01$, $\eta^2 = .11$, with the BPD group reporting more negative emotions overall, compared with the NPC group, $p = .00$, but not significantly different from the MDD group, $p = .29$. In addition, there was an effect of Condition, $F(1, 91) = 5.13$, $p = .03$, $\eta^2 = .05$, such that the Accept group reported significantly more negative emotions than the Suppress group, $p = .03$. There was an effect of Time x Group, $F(4, 182) = .87$, $p = .02$, $\eta^2 = .06$. Pairwise comparisons revealed that this difference between conditions was only significant within the BPD group, $p = .03$, rather than in the MDD, $p = .40$ group, or NPC group, $p = .35$. There were no significant effects of Group x Condition, $F(2, 91) = .49$, $p = .62$, $\eta^2 = .01$. Time x Condition, $F(2, 90) = .86$, $p = .43$, $\eta^2 = .02$, or Time x Group x Condition, $F(4, 182) = .00$, $p = .98$, $\eta^2 < .001$.

In terms of positive self-reported emotions, a Time x Group x Condition repeated measures ANOVA, with Bonferroni adjustments for familywise error for follow-up pairwise comparisons, revealed an effect of Time, $F(2, 90) = 3.64$, $p = .03$, $\eta^2 = .08$, with the higher endorsements of positive emotion in the final baseline, compared with following the emotion induction, $p = .03$, although no different from baseline, $p = .45$. There was no effect of Group $F(2, 91) = 2.43$, $p = .09$, $\eta^2 = .05$. There were also no significant effects of Condition, $F(1, 91) = .34$, $p = .63$, $\eta^2 < .001$, Time x Group, $F(4, 182) = .07$, $p = .14$, $\eta^2 = .04$, Time x Condition, $F(2, 90) = .58$, $p = .56$, $\eta^2 = .01$, or Time x Group x Condition, $F(4, 182) = .02$, $p = .78$, $\eta^2 = .01$. The results of these repeated measures ANOVAs are similar to the pattern of findings from the GLMM approach, reflecting an overall effect of Time and Group, and greater differences between conditions among the BPD group.

Cardiac pre-ejection period.

In a Time x Group x Condition repeated measures ANOVA with weight included as a covariate, there were no significant effects of Time, $F(2, 58) = .49$, $p = .61$, $\eta^2 = .02$, Group, $F(2, 59) = .54$, $p = .59$, $\eta^2 = .02$, or Condition, $F(1, 59) = 1.68$, $p = .20$, $\eta^2 = .03$. Neither were there significant effects of Time x Group $F(4, 118) = .25$, $p = .91$, $\eta^2 = .01$, Time x Condition $F(2, 58) = 1.75$, $p = .18$, $\eta^2 = .06$, Group x Condition, $F(2, 59) = .31$, $p = .74$, $\eta^2 = .01$, or Time x Group x Condition $F(4, 118) = 1.96$, $p = .11$, $\eta^2 = .06$. These findings stand in contrast to that of the GLMM analyses, which suggested a Time x Group x Condition interaction.

Skin conductance.

Similar to the GLMM analyses, a Time x Group x Condition repeated measures ANOVA with SC level as the DV and height, cardiac medication, and dissociation as covariates revealed an effect of Group, $F(2, 73) = 44.59$, $p < .001$, $\eta^2 = .55$, such that the BPD group had lower levels of SC, compared with the MDD and NPC groups, and the NPC group had higher levels of SC, compared with the BPD and NPC groups, *p*s < .001. There was also an effect of Time, $F(2, 72) = .32.37$, $p < .001$, $\eta^2 = .47$, with greater SC levels during the emotion induction, compared after the mirror-tracing task, *p*s < .001. There were no effects of Condition, $F(2, 73) = 1.75$, $p = .19$, $\eta^2 = .02$, Group x Condition, $F(2, 73) = .22$, $p = .80$, $\eta^2 = .01$, Time x Group, $F(4, 146) = 22.10$, $p = .33$, $\eta^2 = .\ 03$, Time x Condition, $F(2, 72) = .01$, $p = 1.00$, $\eta^2 < .\ 001$, or Time x Group x Condition, $F(4, 146) = .73$, $p = .69$, $\eta^2 = .\ 02$.

In terms of SC responses, an ANOVA with age as a covariate revealed no significant effect of Time, $F(2, 62) = 1.14$, $p = .33$, There were no effects of Group, $F(2, 63) = 1.39$, $p = .26$, $\eta^2 = .04$, Condition, $F(2, 63) = .44$, $p = .51$, $\eta^2 = .01$, Group x Condition, $F(2, 63) = 1.10$, $p = .34$, $\eta^2 = .03$, Time x Group, $F(4, 126) = 1.10$, $p = .36$, $\eta^2 = .03$, Time x Condition, $F(2, 62) = .60$, $p = .55$, $\eta^2 = .02$, or Time x Group x Condition, $F(4, 126) = .95$, $p = .44$, $\eta^2 = .03$. There was, however, an effect of Time in a multivariate test, $F(2, 62) = 8.55$, $p < .001$, $\eta^2 = .22$. This was in the same direction as the GLMM analyses, with significantly fewer SC responses after the emotion induction compared with during the emotion induction or at baseline, *p*s < .001.

Respiratory sinus arrhythmia.

The Time x Group x Condition repeated measures ANOVA with RSA as the DV and height and cardiac medications as covariates revealed a similar pattern of findings as the GLMM. There was nearly significant Time x Group interaction, $F(4, 154) = .2.37$, $p = .055$, $\eta^2 = .06$. There was also a non-significant effect of Group, $F(2, 77) = 2.39$, $p =$

.10, $\eta^2 = .06$, There were no effects of Time, $F(2, 76) = .07$, $p = .93$, $\eta^2 < .001$, Condition, $F(1, 77) = 1.77$, $p = .19$, $\eta^2 = .02$, Group x Condition, $F(2, 77) = .22$, $p = .80$, $\eta^2 = .01$, Time x Condition, $F(2, 76) = .74$, $p = .48$, $\eta^2 = . 02$, or Time x Group x Condition, $F(4, 154) = 1.64$, $p = .17$, $\eta^2 = . 04$.

Facial electromyography.

With regard to zygomatic activation, the repeated measures ANOVA revealed an effect of Time, $F(2, 57) = 6.35$, $p < .001$, $\eta^2 = .18$, such that levels of zygomatic activity were significantly lower after the emotion induction, compared with during or at baseline, *p*s < .001. There were also significant effects of Time x Group x Condition, $F(4, 116) = 2.95$, $p = .02$, $\eta^2 = . 09$, and Group x Condition, $F(2, 58) = 3.17$, $p = .049$, $\eta^2 = .10$, suggesting that the effects of time only emerged in the MDD Accept group, and the BPD suppress group, *p*s = .00. There were no effects of Group, $F(2, 76) = .07$, $p = .93$, $\eta^2 < .001$, Condition, $F(1, 77) = 1.77$, $p = .19$, $\eta^2 = .02$, Time x Group, $F(4, 116) = 1.91$, $p = .11$, $\eta^2 = . 06$, or Time x Condition, $F(2, 57) = .21$, $p = .81$, $\eta^2 = .01$.

With regard to corrugator activity, the repeated measures ANOVA was conducted with weight as a covariate. There was an effect of Time, $F(2, 55) = 4.09$, $p = .02$, $\eta^2 = .13$, such that levels of corrugator activity were significantly lower after the emotion induction, compared with during or at baseline, *p*s < .001. There were no effects of Group, $F(2, 56) = .1.21$, $p = .31$, $\eta^2 = .04$, Condition, $F(1, 56) = .35$, $p = .56$, $\eta^2 = .01$, Group x Condition, $F(2, 56) = .61$, $p = .55$, $\eta^2 = .02$, Time x Group, $F(4, 112) = .95$, $p = .44$, $\eta^2 = . 03$, or Time x Condition, $F(2, 55) = .74$, $p = .48$, $\eta^2 = .03$, or Time x Group x Condition, $F(4, 112) = 1.13$, $p = .35$, $\eta^2 = . 04$.

Aim 2 examined using ANOVAs

Urges.

In a Time x Group x Condition repeated measures ANOVA with total urges at the DV and dissociation as a covariate, there was a Group x Condition interaction, $F(2, 88) = 4.16$, $p = .02$, $\eta^2 = .09$, such that the Accept condition reported higher urges, compared with the Suppress condition, but only among the BPD group, $p < .001$, and not the NPC group, $p = .82$, or the MDD group, $p = .72$. There were no effects of Time, $F(2, 87) = 2.17$, $p = .12$, $\eta^2 = .05$, Group, $F(2, 88) = .14$, $p = .87$, $\eta^2 < .001$, Condition, $F(1, 88) = 2.09$, $p = .15$, $\eta^2 = .02$, Time x Group, $F(4, 176) = 1.08$, $p = .37$, $\eta^2 = .02$, or Time x Condition, $F(2, 87) = .07$, $p = .93$, $\eta^2 < .001$, or Time x Group x Condition, $F(4, 176) = .5$, $p = .97$, $\eta^2 < . 001$. These results differ from that of the GLMM, which demonstrated higher urges among the BPD group, and more urges over time. However, the pairwise comparisons in the GLMM suggested that the condition effects emerged only within the BPD group, in line with the results of the ANOVA.

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