FEELING HOLLOW: EXAMINING THE PRESENCE, EMOTIONAL CORRELATES, AND REGULATION OF EMPTINESS IN BORDERLINE PERSONALITY DISORDER

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Abstract

This study examines whether 1) emptiness at baseline and emptiness in response to stressors (i.e., emptiness reactivity) is elevated in BPD relative to clinical and healthy controls (HCs), 2) whether emptiness reactivity predicts emotion reactivity across different indices of emotion, 3) and whether emptiness can be reduced using emotion regulation strategies (i.e., distraction, mindfulness). Participants (N = 120) with either BPD, generalized anxiety disorder (GAD), or HCs provided measurements of emptiness, self-reported emotion, skin conductance response (SCR), and respiratory sinus arrhythmia (RSA) at baseline, following a stressor, and while implementing an ER strategy. Results revealed that baseline emptiness was highest in the BPD group and that increases in emptiness predicted increases and decreases in emotional reactivity via self-report and RSA, respectively. Only distraction predicted greater reductions in emptiness compared to simply reacting across groups. Therefore, distraction may be most effective in reducing emptiness in the short-term compared to mindfulness.

Keywords: emptiness, borderline personality disorder, emotion regulation, emotion dysregulation

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Introduction

BPD and Chronic Feelings of Emptiness

Borderline personality disorder (BPD) is a complex personality disorder characterized by emotion dysregulation, interpersonal problems, impulsive and self-destructive behaviours, identity disturbance, and chronic feelings of emptiness (American Psychiatric Association, 2013). BPD can be a highly disabling condition, affecting one's interpersonal, vocational, and psychological functioning (Gunderson et al., 2011; Winsper et al., 2015). For example, BPD is related to reduced work productivity (Gunderson et al., 2011), unemployment (Skodol et al., 2002), poor academic performance (Bagge et al., 2004), impaired romantic and non-romantic relationships (Clifton et al., 2007; Hill et al., 2008), and reduced overall quality of life (Chakhissi et al., 2021). BPD is also a life-threatening disorder associated with an increased risk of suicide and self-harm, such that approximately 84% of people with BPD engage in self-injurious behaviour (Soloff et al., 2002) and approximately 10% die by suicide (Paris & Zeig-Frank, 2001). Suicide and self-harm in BPD have recently been linked to chronic feelings of emptiness (Grilo & Udo, 2021; Yen et al., 2021), a diagnostic criterion of BPD that is rarely studied and not well understood (Elsner et al., 2017). In addition, research suggests that chronic emptiness is associated with greater psychosocial morbidity compared to other symptoms of BPD such as affective instability and impulsivity (Ellison et al., 2016). Given the significant functional impairments associated with chronic emptiness and the dearth of literature examining it, this study examines the presence of emptiness in BPD, its relation to core emotional components of the disorder, and effective strategies for reducing it.

Emptiness in BPD

In the Diagnostic and Statistical Manual of Mental Disorders (5th Edition) (DSM-5), chronic feelings of emptiness are listed as one of the nine diagnostic criteria for BPD (APA, 2013). The prevalence of chronic emptiness in a nationally representative sample of individuals meeting BPD diagnostic criteria has been reported to be around 68.4% (Grilo & Udo, 2021). Among BPD samples, emptiness is more prevalent in females than males (Hoertel et al., 2014) and more severe in older adults than younger adults (Morgan et al., 2013). There is evidence that feelings of emptiness in BPD have a chronic course, as its name implies (Morgan et al., 2013; Zanarini et al., 2016). In a BPD sample, emptiness took an average of 8-10 years to remit, which was longer than other symptoms of BPD such as self-harm and suicidal behaviours (Zanarini et al., 2007). Additionally, emptiness was associated with poorer remission rates compared to other BPD symptoms after a 16-year follow-up (Zanarini et al., 2016). Altogether, previous research has demonstrated that emptiness is a common symptom among BPD populations, has a chronic course, and is associated with slower treatment recovery compared to other BPD symptoms.

Defining Emptiness

Despite the reported high prevalence of chronic emptiness in BPD, researchers and theorists have yet to establish consensus with respect to what emptiness is. Several issues with defining emptiness have been discussed throughout the literature (e.g., D'Agostino et al., 2020; Klonsky, 2008; Miller et al., 2020; Peteet, 2011; Widiger et al., 1995). First, some researchers have reported confusion pertaining to the definition of the term among clinical samples such that respondents do not understand the meaning of emptiness or how to answer to questions assessing it (e.g., Rebok et al., 2015; Widiger et al., 1995). Indeed, Masland et al. (2020), notes that emptiness is a subjective description of an emotional state that is difficult to define universally.

This is especially evident considering that chronic emptiness has been described in numerous ways, including a feeling of nothingness, vagueness, purposelessness, hollowness, woodenness, internal absence, a hole, a void, or a vacuum (Elsner et al., 2017). While additional guidelines for assessing emptiness have been suggested (e.g., absence of meaning or purpose; Widiger et al., 1995), it is possible that the subjective experience of emptiness is unique to each individual (Didonna & Gonzalez, 2009). Indeed, there is currently no universally agreed upon definition that encompasses the various ways that chronic emptiness is described in BPD and across clinical populations more broadly (Miller et al., 2020).

Relatedly, it is also unclear whether chronic emptiness is best conceptualized as an emotion, symptom, "defence mechanism", existential state, or all or none of the above (D'Agostino et al., 2020). Although emptiness is most often described as an emotional state, descriptions often include other features that extend beyond emotional components such as an existential state of purposelessness, symptoms of dysphoria (e.g., low mood, feelings of sadness, lack of interest or pleasure in activities), or its function as a coping mechanism to avoid intense or unpleasant emotions (Elsner et al., 2017). Finally, blurred boundaries between chronic emptiness and other related constructs such as hopelessness, loneliness, and boredom have also contributed to conceptual issues (Klonsky, 2008; Miller et al., 2020). In particular, both emptiness and hopelessness are closely related constructs that are independently associated with suicide and self-injury (D'Agostino et al., 2020; Klonsky, 2008). Despite their association, Miller et al. (2020) draw the distinction that emptiness is a sense of disconnection from both self and others, whereas hopelessness is a sense of disconnection from meaning or life. In addition, emptiness and loneliness are also related constructs (Clum, 1997; Klonsky, 2008) that are often used interchangeably (Zanarini et al., 2007). However, while emptiness is purportedly

characterized by a feeling of disconnection from others, loneliness is theorized to be a sense of disconnection from the world and intolerance of being alone (Miller et al., 2020). Finally, boredom was previously considered to be a diagnostic criterion for BPD until studies suggested that it was a less discriminating feature of the disorder than chronic emptiness (Klonsky, 2008). Although feelings of emptiness are related to boredom, evidence suggests that boredom is a goal-driven state that often dissipates after an individual engages in an activity (Bench & Lench, 2013), whereas emptiness tends to persist after engaging in activities (Klonsky, 2008).

In sum, the conceptual issues surrounding chronic emptiness include the variability in which emptiness is defined and its distinction from other related constructs. As a result, chronic emptiness has been a challenging phenomenon to empirically assess and study (Zerach, 2016). According to Miller et al. (2020), the lack of a consensus definition of emptiness has led to inconsistent findings regarding its association with other symptoms of BPD. In their review of the literature on emptiness, only one study (i.e., Price et al., 2019) included an empirical investigation into the nature of emptiness and its features (Miller et al., 2020). Based on their thematic analysis of online content and transcripts from interviews with clinical patients, Price et al. (2020) identified core features of emptiness which include feelings of absence from one's own life, lack of fulfillment, the experience of forced existence (i.e., "I feel like I am forced to exist"), and profound aloneness. Given that it is the only study to provide an empirical basis for the nature of emptiness, the results from Price et al. (2019) represent a first step towards resolving the above conceptual issues and establishing an operational definition for chronic emptiness in BPD.

The Relationship between Emptiness and Negative Outcomes

While research is still in its early stages, there has been a burgeoning interest in chronic feelings of emptiness in BPD and its deleterious correlates (D'Agostino et al., 2020; Miller et al., 2020; Price et al., 2020). These studies generally suggest that emptiness may be a particularly problematic symptom for individuals with BPD that entails a host of negative sequelae or correlates. For example, chronic emptiness is robustly associated with depression and dysphoria (Heisel et al., 2005; Klonsky, 2008; Price et al., 2020). Indeed, Klonsky (2008) found a moderate correlation between emptiness and depression in a sample of college students, even after controlling for anxiety. Among people with BPD, those who endorse chronic emptiness experience more severe depression than those who do not (Johansen et al., 2004). While the causal relationship between these constructs has yet to be empirically investigated, D'Agostino et al. (2020) suggest that dysphoria can be considered as a broader emotional state that encompasses emptiness along with other negative feelings such as unhappiness, a sense of failure, and hopelessness. Thus, while emptiness is associated with negative emotions such as depression and dysphoria, the nature of their causal relationship remains unknown.

As previously mentioned, emptiness is also associated with suicidal and self-harming behaviours (Grilo & Udo, 2021; Yen et al., 2021). In the general population, one study found that 67% of college students reported feeling empty prior to engaging in self-harm behaviours (Klonsky, 2008). Supporting these findings, another study found that chronic emptiness was associated with a history of self-harm, indicating that emptiness may be a motivation for engaging in these behaviours among college students (Brickman et al., 2014). In a clinical sample, emptiness was also found to be associated with a greater risk of dysfunctional behaviours including self-harm after treatment (Miller et al., 2018). In a BPD sample, chronic

emptiness is associated with an increased odds of lifetime suicide attempts and past year suicide attempts (Grilo & Udo, 2021). In addition, emptiness predicted suicide attempts after a 10-year follow-up among those with BPD (Yen et al., 2021). Collectively, these findings suggest that chronic emptiness is associated with an increased risk of suicide and self-harm, especially among those with BPD. Researchers have explained these findings by suggesting that suicidal and self-harming behaviours may be an attempt to relieve the tension caused by feelings of emptiness among individuals with BPD (Grilo & Udo, 2021).

Finally, there is evidence that emptiness is linked to social dysfunction (Ellison et al., 2016), and that feelings of emptiness occur most often during interactions with others in close social relationships among those with BPD (Stepp et al., 2009). In one study, those with BPD who endorsed chronic emptiness had poorer psychosocial outcomes (i.e., days out of work, lowest social functioning) compared to those who did not endorse emptiness (Ellison et al., 2016). In addition, emptiness is associated with impaired vocational functioning such as days out of work (Miller et al., 2018). One study revealed that psychiatric outpatients with both chronic emptiness and impulsivity had missed more work in the past five years compared to those without these BPD symptoms (Ellison et al., 2016). Hence, emptiness seems to impair both social and vocational function, particularly among those with BPD. Further, these findings suggest that emptiness may be particularly present in response to social interaction.

Altogether, the above findings suggest that emptiness is not only common in BPD but is also associated with other negative experiences such as depression and dysphoria, self-harm and suicide, and social and vocational dysfunction in general and in BPD specifically. While there is a growing line of research and theory focused on the nature of emptiness and its detrimental correlates, it remains unclear what *specific* forms of emptiness actually characterize BPD and

thus require targeting in BPD treatments. One important consideration that has been overlooked in previous research is the distinction between baseline emptiness and emptiness reactivity. *Baseline* emptiness refers to the feeling of emptiness at baseline (i.e., emptiness prior to the introduction of a given stimuli such as a stressor) while emptiness *reactivity* refers to changes in feelings of emptiness in response to a given stimuli (e.g., emptiness following the introduction of a stressor). Hence, while some literature has examined heightened emptiness in BPD in general (e.g., Grilo & Udo, 2021), it remains unclear based on this research when and how individuals with BPD experience it (i.e., heightened emptiness at baseline, in response to stressors, or both). Additionally, while emptiness is elevated among individuals with BPD in general, little research has compared levels of emptiness across clinical groups and healthy controls, particularly with respect to baseline emptiness and emptiness reactivity. Such an examination would provide important information about whether the experience of emptiness is specific to BPD, or pervasive across clinical groups. Greater precision regarding when and how individuals with BPD experience emptiness, and whether these experiences are truly unique to BPD, will also provide insight into when and how emptiness could be targeted in treatment contexts (e.g., via chronic regular behaviours for baseline emptiness versus strategies to manage emptiness responses after stressors). Therefore, more research examining whether BPD is characterized specifically by elevated emptiness at baseline or emptiness reactivity in comparison to both healthy and clinical control groups is needed. Moreover, considering its associated negative outcomes, as well as its prevalence and chronicity in BPD, it is also critical to provide further empirical insight into *why* emptiness occurs in BPD and how it can be reduced.

Emptiness and Biosocial Theory

The leading etiological theory of BPD known as the Biosocial theory (Linehan, 1993) has attempted to explain the development and maintenance of specific symptoms including emptiness in BPD. According to Linehan (1993), emotion dysregulation is the core of BPD such that it directly or indirectly leads to all other BPD symptoms. Emotion dysregulation specifically refers to abnormal emotion processes and difficulties regulating them (Linehan, 1993). Abnormal emotion processes include heightened emotion sensitivity (i.e., lower threshold for emotion), heightened emotion reactivity (i.e., greater increase in emotion after an emotion induction), slow return to baseline (i.e., slower decreases in emotion after an emotion induction; Linehan, 1993). The Biosocial theory stipulates that a biological vulnerability to emotion dysregulation and an invalidating social environment (i.e., an environment where one's communication of internal experiences is often met by neglect, negation, or disregard) transact over time, leading to the development of emotion dysregulation and, consequently, BPD symptoms (Linehan, 1993; Crowell et al., 2009).

According to the Biosocial theory, invalidating responses to one's inner experiences in early life can lead to the inhibition of negative emotions or 'emotional numbness.' This emotional numbness is often experienced as a feeling of emptiness such that individuals with BPD "often try to control their emotions by forcing themselves *not to feel* what they are experiencing" (Linehan, 1993). Drawing from this, some theorists suggest that emptiness occurs in BPD as a maladaptive form of emotion regulation that downregulates intense emotional experiences associated with the disorder (e.g., Didonna & Gonzalez, 2009). In particular, Didonna & Gonzalez (2009) suggest that emptiness is akin to experiential avoidance, which is the tendency to escape from unwanted emotional experiences and is considered a maladaptive

coping strategy (Chapman et al., 2011; Hayes et al., 1996). In this way, emptiness serves as a maladaptive attempt to inhibit or numb intense negative emotional experiences in BPD, such as heightened emotional reactivity (Didonna & Gonzalez, 2009).

However, research on the presence of some components of emotion dysregulation themselves in BPD, including heightened emotional reactivity, are themselves mixed. While some studies report heightened emotional reactivity among individuals with BPD compared to control groups (e.g., Dixon-Gordon et al., 2013; Gratz et al., 2019; Chapman, & Tull, 2019), others do not (e.g., Elices et al., 2012; Kuo et al., 2016; Pfaltz et al., 2015). With regard to physiological measures of emotion, some studies report heightened sympathetic and parasympathetic reactivity in BPD compared to control groups (e.g., Austin et al., 2007; Ebner-Priemer et al., 2005; Rosenthal et al., 2016), while others report lower sympathetic reactivity (e.g., Pfaltz et al., 2015) or no differences (e.g., Baschnagel, et al., 2013; Chapman et al., 2015; Dixon-Gordon et al., 2015). One possibility for these mixed findings may be due to variability in emptiness. That is, individuals higher in emptiness may be likely to evince lower emotional reactivity due to the emotion regulatory function of emptiness in downregulating emotional reactivity. In a similar vein, individuals lower in emptiness may be likely to show higher emotional reactivity. Thus, the mixed findings regarding heightened emotional reactivity in BPD may be due to variability in emptiness which theoretically serves an emotion regulatory function. However, little empirical work has examined whether emptiness in BPD specifically functions to downregulate heightened emotional reactivity.

Emptiness and Emotion Reactivity

The literature on the relationship between emptiness and emotional reactivity in BPD is scarce. Only one study has systematically examined the emotional components of emptiness

(Klonsky, 2008). Klonsky (2008) found that emptiness is a common emotional state among people who self-injure, and experts in emotion research rated emptiness as high in negative affective *valence* but low emotional *arousal*. Negative affective valence and low arousal suggests that emptiness is highly negative "in tone" but is also associated with lower emotional intensity or reactivity, which aligns with the theoretical assertion that emptiness may be a form of emotional numbness. Thus, these findings point to the possibility that emptiness may dampen emotion reactivity when elicited, thereby serving an emotion regulatory function in line with the theoretical literature (e.g., Didonna & Gonzalez, 2009). However, ratings of arousal and valence were based on expert judgments, and it remains unclear whether emptiness dampens emotion in those who experience it. Furthermore, emotions are multifaceted, encompassing both subjective and physiological (e.g., sympathetic and parasympathetic nervous system) reactions, and probing the relationship between emptiness and emotional reactivity therefore requires the assessment of emotion using different methods (Gross & John, 1997). Sympathetic indices of emotion– such as skin conductance responses (SCR) assess activity in the sympathetic nervous system. SCRs specifically measure the electrical variation in skin conductance from sweat secretion on the epidermis, which has been linked with fluctuations in emotional arousal (Craske et al., 2008; Dawson et al., 2007). Conversely, parasympathetic measures of emotion– such as respiratory sinus arrhythmia (RSA)– assess activity in the parasympathetic nervous system. RSA is a measure of heart rate variability, which is calculated using the amplitude of heart rate oscillations between inhaling and exhaling (Porges, 2007). RSA has been demonstrated to be a reliable and objective proxy for parasympathetic influence on emotion after an emotion induction (e.g., emotionally salient film fragments and pictures) (Overbeek et al., 2012). Previous research suggests that different indices of emotional responding, such as sympathetic nervous system

activation, parasympathetic nervous system activation, and self-reported measures of emotion are independent of each other (Berntson, 1994; Rosenthal et al., 2008). Therefore, an examination into whether emptiness dampens emotional reactivity requires the comprehensive use of self-reported, sympathetic, and parasympathetic indices of emotion.

In addition to using different measures of emotional responding, it is important to examine whether these effects are specific to BPD or pervasive across clinical groups who also experience emotion dysregulation. One clinical population also characterized by emotion dysregulation is generalized anxiety disorder (GAD) (Mennin et al., 2005; Newman et al., 2011). GAD is an anxiety disorder characterized by excessive and uncontrollable anxiety or worry causing impairment in an individual's daily life (APA, 2013). GAD would be a useful comparison group to determine whether the emotionally dampening effects of emptiness are unique to BPD or to high emotion dysregulation groups in general. However, little research has examined chronic emptiness in GAD and whether it also serves an emotion regulatory function in the disorder. Given that emotion dysregulation is theoretically the core feature of – and also particularly pronounced in – BPD, and that emptiness theoretically develops as a method of regulating one of the components of emotion dysregulation (i.e., emotional reactivity), the emotional dampening effects of emptiness may be greater in BPD than in other clinical groups like GAD. However, this has not been studied. Comparing the relationship between emptiness on emotional reactivity across BPD, GAD, and healthy controls will shed light on whether the potential emotion regulatory function of emptiness is unique to BPD, specific to clinical populations with experiential avoidance and emotion dysregulation, or pervasive across groups.

Emptiness and Emotion Regulation

Finally, in addition to a lack of clarity regarding the nature of emptiness in BPD and its relationship with emotion processes, it remains unclear how it can be reduced. There is evidence that individuals with BPD perceive themselves to be ineffective at regulating emotions, although they do not demonstrate deficits in reducing emotion using emotion regulation strategies that they are trained in (Daros et al., 2019; Fitzpatrick & Kuo, 2016; Southward & Cheavens, 2020). BPD treatments such as dialectical behaviour therapy (DBT) provide a number of emotion regulation strategies to reduce painful emotional experiences such as emptiness (Linehan, 1993; 2015; Lynch et al., 2006). However, there are many different emotion regulation strategies. Indeed, emotion regulation strategies have been distinguished according to whether they engage with emotion or disengage from it (Sheppes & Meiran, 2008; Sheppes et al., 2011). Two particularly relevant strategies to BPD treatment that cut across these categories are mindfulness (i.e., engaging with emotion) and distraction (i.e., disengaging with emotion) (Linehan, 1993; 2015). Mindfulness involves nonjudgmentally noticing internal experiences without rejection or amplification (Kuo et al., 2016; Erisman & Roemer, 2010). In this way, mindfulness functions to redirect attention towards emotional content. Some have theorized that mindfulness may be an effective strategy for reducing emptiness given that it involves directing attention towards emotional states, unlike emptiness which theoretically inhibits them, thereby allowing the emotions to be processed and downregulated (Didonna & Gonzalez, 2009). In contrast, distraction involves redirecting attention away from emotionally evocative stimuli, thereby preventing heightened emotional intensity (Sheppes et al., 2011). Distraction may therefore function in a theoretically similar way to emptiness by facilitating avoidance of emotions, as they direct attention away from intense emotions, preventing them from being processed and

downregulated (Sheppes et al., 2011). As such, it is questionable whether disengagement strategies are likely to be effective in reducing emptiness, or possibly increase it. However, no previous research has tested this experimentally, and it is currently unknown whether these strategies are effective for decreasing emptiness and, if so, which one is most effective.

Current Study

In summary, chronic emptiness in BPD is poorly understood. There are a range of issues related to defining chronic emptiness in BPD, which has led to complications in its assessment and empirical investigation. As such, research on emptiness in BPD remains largely theoretical and it is unclear which components of emptiness (i.e., baseline or reactivity) are elevated in the disorder. According to some theorists (e.g., Didonna & Gonzalez, 2009), emptiness functions as an emotion regulation strategy that dampens intense emotional experiences associated with BPD. While there is some indirect support for this assertion (e.g., Klonsky, 2008), there are currently few studies that examine the relationship between emptiness and emotional reactivity, and how it can be reduced. Therefore, the current study seeks to examine:

1) Whether BPD is characterized by elevated baseline emptiness relative to individuals with GAD and HCs

- We hypothesized that BPD will be associated with higher baseline emptiness compared to GAD and HCs.

2) Whether BPD is characterized by elevated emptiness reactivity relative to individuals with GAD and HCs

- We hypothesized that BPD will be associated with higher emptiness reactivity (i.e., rises in emptiness after an emotion induction) compared to GAD and HCs.

3a) Whether increases in emptiness are associated with decreases in emotional responding

- We hypothesized that increases in emptiness will predict lower emotional reactivity across physiological and self-report indices.

3b) Whether such potentially dampening effects of emptiness reactivity on emotional reactivity are more pronounced among individuals with BPD compared to healthy or high emotion dysregulation clinical control groups

- We hypothesized that the relationship between increases in emptiness and decreases in emotional reactivity will be greater in BPD compared to GAD and HCs.

4) Whether engagement emotion regulation strategies (i.e., mindfulness) are associated with greater reductions in emptiness than disengagement emotion regulation strategies (i.e., distraction)

- We hypothesized that mindfulness will be associated with greater reductions in emptiness compared to distraction. We also examined group differences in this effect as an exploratory and secondary question. However, given a dearth of literature in this area, we considered this investigation exploratory and offer no hypotheses.

Method

Participants

The current study is a secondary analysis of a parent study examining emotion dysregulation components across individuals with BPD and other clinical groups (i.e., Fitzpatrick et al., 2020). One hundred and twenty individuals with either BPD (n = 40), GAD (n = 40), or HCs (n = 40) matched on age and sex were recruited online and through the distribution of fliers. In line with other BPD studies (e.g., Elices et al., 2012; Kuo & Linehan, 2009), the exclusion criteria consisted of having health conditions or taking several medications (e.g., H1 histamine receptor blockers (Licht et al., 2010) that influence psychophysiology and task completion,

including several comorbid medical (e.g., heart/respiratory conditions) and psychiatric conditions (i.e., alcohol or substance use dependence, bipolar I disorder, and severe psychotic disorder). To control for symptom overlap across BPD and control groups, potential participants in the GAD and HC groups were excluded if they endorsed four or more BPD criteria, or the self-harm/suicidality or impulsivity criterion of BPD. In addition, HCs were excluded if they endorsed any current psychiatric diagnoses or were currently taking any psychiatric medications.

For the BPD group, the mean age was 25.35 (*SD* = 6.77), the majority of the sample was female (82.5%), and the most common race/ethnicity was White/Caucasian/European origin (40.0%). For the GAD group, the mean age was 25.95 (*SD* = 7.20), the majority of the sample was female (78.9%), and the most common race/ethnicity was White/Caucasian/European origin (34.2%). For the HC group, the mean age was 24.70 (*SD* = 6.88), the majority of the sample was female (80.0%), and the most common race/ethnicity was Chinese or Chinese-Canadian (30.0%). According to Fitzpatrick et al. (2020), there were several comorbidities found across the BPD and GAD groups, the most common being major depressive disorder (BPD = 30%; GAD = 20%), social anxiety disorder (BPD = 45%; GAD = 42.5%), specific phobia (BPD = 17.5%; GAD = 25%), obsessive compulsive disorder (BPD = 32.5%; GAD = 15%), and GAD (BPD = 40.0%; Fitzpatrick et al., 2020).

Measures

McLean Screening Instrument for Borderline Personality Disorder (MSI-BPD; Zanarini et al., 2003). The MSI-BPD was used to screen for probable BPD online or by phone prior to attending a more thorough assessment at the laboratory. The MSI-BPD is a 10-item self-report measure based on a subset of items from the Borderline module of the Diagnostic Interview for DSM-IV-TR Personality Disorders (DIPD-IV; Zanarini et al., 1996) used to screen

for BPD symptoms. A cut-off score of 7 is generally considered to indicate the potential presence of BPD (Zanarini et al., 2003). With regard to its psychometric properties, previous research has indicated that the MSI-BPD has adequate levels of internal consistency (Zanarini et al., 2003). The reported sensitivity and specificity for the MSI-BPD for the cut-off score of 7 is .81 and .85, respectively, and even higher among younger participants (i.e., 30 years or younger; sensitivity = .87; specificity = .90). In addition, the MSI-BPD has been demonstrated to have good convergent validity with other measures of BPD such as the Personality Assessment Inventory-Borderline Features Scale (PAI-BOR) and other theoretically related criteria (Gardner & Qualter, 2009). The cut-off score to reach the next stage of screening was four to five or more for BPD (depending on mode of screening) and less than seven for the GAD group.

Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders-IV-TR (SCID-IV-TR; First et al., 2002). In order to characterize the sample, interviews were administered by undergraduate and masters-level students who were trained to reliability against a gold-standard assessor and supervised by a licensed clinical psychologist. The SCID was used to assess for GAD and diagnostic comorbidities. The SCID is a semi-structured clinical interview that is widely used for detecting current and lifetime psychiatric disorders in the Diagnostic Manual of Mental Disorders 4th edition- text revision (DSM-IV-TR; APA, 2000). The SCID-IV-TR has been demonstrated to have good to excellent levels of inter-rater reliability across different disorders with Kappa values ranging from 0.60–1.0 (Lobbestael et al., 2011; Zanarini et al., 2000). In terms of validity, studies have demonstrated superior validity of SCID diagnoses over best estimate diagnoses from standard clinical interviews at intake (Fenning, et al., 1994). In addition, the SCID-IV-TR severity dimensions have been demonstrated to have excellent levels of internal consistency (all Cronbach's αs >.80), test-retest

reliability, concurrent, and predictive validity (Shankman et al., 2018). In Fitzpatrick et al. (2020), prevalence-adjusted bias-adjusted kappas (PABAKs; Byrt, et al., 1993) with the gold-standard assessor ranged from .67 to 1.00 across modules and the average PABAK for SCID-IV-TR was .97.

International Personality Disorders Examination- BPD Module (IPDE-BPD module; Loranger et al., 1994). The IPDE-BPD module was used to assess for the presence of BPD. The IPDE-BPD module is a semi-structured interview that assesses the presence of BPD from the ICD-10 (International Classification of Disease, 10th edition; World Health Organization, 1992) and the DSM-IV-TR and DSM-5 (APA, 2000; 2013). The IPDE has been demonstrated to have good to excellent levels of interrater reliability for both categorical and dimensional diagnoses of BPD (Carcone et al., 2015). Furthermore, dimensional assessments of BPD using the IPDE have moderate correlations with self-report inventories of BPD, demonstrating some convergent validity (Blackburn et al., 2004). The average PABAK value across assessors with the gold standard assessor for IPDE-BPE in Fitzpatrick et al. (2020) was .95.

Emptiness. A Visual Analogue Scale (VAS) was used to assess emptiness. A VAS is a psychometric response scale where individuals rate the extent to which they agree to a given statement by indicating a position along a continuous line between two endpoints (McCormack et al., 1988). Participants rated their level of agreement to the statement "I feel empty" from 0 (not at all empty) to 100 (very empty) on the VAS before and after each emotion induction, and after the implementation of emotion regulation strategies (See below for procedure). Previous research on VAS' of emotion has reported its inter-item reliability (.70-.91) (Carlson et al., 1989)

and its convergent validity (Stern, 1997) with related measures such as the Profile of Mood States (POMS; McNair et al., 1981).

Emotion Indices

Self-reported emotional intensity. Self-reported emotional intensity was indexed as participant ratings using a continuous rating dial (RD; Ruef & Levenson, 1992). The RD is a dial that raters slide left and right to report their emotional valence on a 9-point scale to reflect their degree of negative emotion from 0 (very negative) to 9 (very positive). Participant affect ratings are consistent with their spouses' ratings and observers' objective coding, as well as physiological measures, demonstrating its validity for assessing continuous changes in emotion (Ruef & Levenson, 1992). Participants were instructed to keep their hand on the RD throughout the experiment and adjust it to reflect shifts in negative emotion. Continuous RD recordings were decomposed into 30-second epochs.

Skin conductance responses (SCRs). SCR was used as a measure of sympathetic emotional activity. SCR is a commonly used indirect measure of sympathetic autonomic activity that is associated with emotional arousal (Craske et al., 2008; Laine et al., 2009). SCR is considered to be a reliable index of various complex behaviours, including emotional responding (Craske et al., 2008). Electrodes were placed on the medial middle and index fingertips of each participant's non-dominant hand. As outlined in Fitzpatrick et al. (2020), SCRs were digitized using low (35Hz) and high (.05 Hz) pass filters at 1000 samples per second with a gain of 1000. SCRs were processed using Mindware Technologies EDA 2.40 program and was indexed as the number of responses exceeding 0.05 μS per 30-second epoch. SCRs were continuously recorded and were analysed in 30-second epochs.

Respiratory sinus arrhythmia (RSA). RSA was used as an index of parasympathetic emotional reactivity. RSA specifically measures increases and decreases in heart rate after adjusting for the rhythmic influence of respiration and its association with the amplitude of heart rate oscillations between inhaling and exhaling (Porges, 2007). The amplitude of RSA is often used as a method to quantify vagal tone (Porges, et al., 1995). According to Porges' polyvagal theory (e.g., Porges, 1995; Porges, et al., 1996), the vagal system facilitates physiological homeostasis by preserving resources at rest and responding to external demands when needed. Parasympathetic activity results in a high vagal tone or RSA while at rest, which is associated with slower heart rate (Porges, et al. 1995). In contrast, parasympathetic activity is reduced when responding to a given stressor, causing heart rate to increase, allowing the organism to meet environmental demands (Porges, et al., 1995). RSA is quantified and used as a proxy for parasympathetic influences on emotion in various ways, including assessing vagal withdrawal (i.e., decreases in RSA) as an indicator of higher emotional reactivity (Porges et al., 1996). There is evidence that individuals with BPD exhibit increased vagal withdrawal in response to an emotion induction (i.e., film clips) compared to non-clinical controls, indicating heightened emotion reactivity (Austin et al., 2007). Hence, vagal withdrawal measured through RSA can be a useful indicator of emotional reactivity, particularly among individuals with BPD.

In Fitzpatrick et al. (2020), a two-electrode electrocardiography configuration with a bioimpedance module for grounding was used with a respiratory band around the chest and a sampling frequency of 1000 samples/second. Mindware Technologies HRV 2.33 software was used to calculate R-R intervals across 30-second epochs. Following identifying R-R intervals in accordance with preparing heart rate data, the electrocardiogram was decomposed into three frequency ranges using spectral analysis. Given that cardiac activity below .15 Hz is considered

to reflect sympathetic rather than exclusively parasympathetic influence (Bernston et al., 1997), RSA was measured using the highest frequency band of spectral analysis (i.e., greater than .15 Hz). Mindware Technologies HRV 2.33 implemented a validated algorithm to calculate spectral densities with this high frequency band continuously across 30-second epochs. All measurements were taken with participants sitting upright with their feet placed on the floor.

Emotion Induction

Given previous research demonstrating that individuals with BPD show increased reactivity to rejection-themed stimuli (Limberg et al., 2011), three 2-minute rejection-themed scripts were developed in the original study to induce emotion. The scripts were based on shorter rejection-themed emotion inductions from the literature (Limberg et al., 2011) and included a standardized number of thoughts (e.g., "you think to yourself 'how could they do this?'"), physiological sensations (e.g., "your heart beats faster"), and emotion words across them. In addition, the intensity of emotional words was standardized across scripts using the emotional intensity coding and categorization method described in Strauss and Allen (2008) (see project page for a detailed description of script development on the Open Science Framework: https://osf.io/cqaj2/). Each script prompted the participant to imagine scenarios of rejection from either 1) a mother, 2) friends, or 3) a romantic partner. These scripts demonstrated equivalent amounts of pre- to post-self-reported general negative emotion in a pilot sample ($N = 55$) of undergraduate students (Fitzpatrick et al., 2020).

Procedures

In the procedure by Fitzpatrick et al. (2020), interested participants were pre-screened online and over the phone using the MSI-BPD. If potentially eligible, they were invited to the lab for an in-person eligibility assessment using the SCID-IV-TR and the IPDE-BPD. Eligible

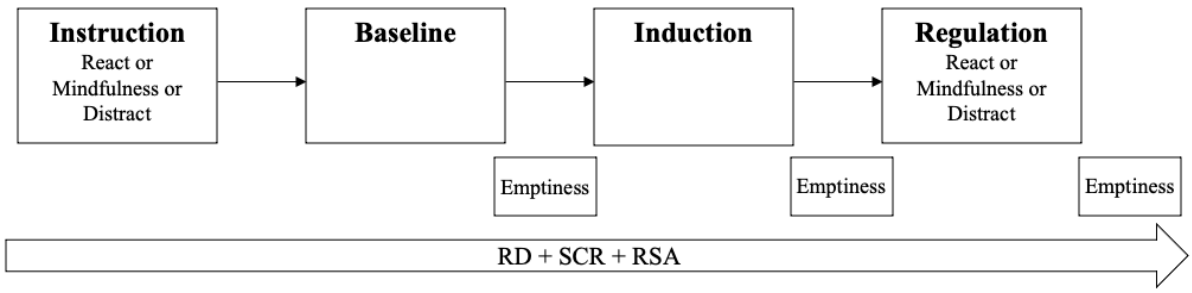
participants returned on a separate day for the experiment where they were instructed on RD use and equipped with the physiological measures.

Participants first completed a 10-minute resting baseline with no stimuli presented where RD, SCR, and RSA measurements were taken, however these data were not examined in the present study. Following this baseline, there were three conditions, each of which was comprised of four phases. In the first phase of each condition (instruction phase), participants were instructed on how to implement an emotion regulation strategy when they are prompted to do so later in the experiment. Participants were asked to repeat instructions to ensure comprehension and research assistants (RAs) provided correction as needed. In the first phase of the "react condition", participants were instructed to react as they normally would when they received a prompt on the screen instructing them to do so. The react condition was used to assess for post-emotion induction recovery in the absence of implementing an active emotion regulation strategy (i.e., mindfulness or distraction). In the first phase of the "mindfulness condition", participants were instructed to nonjudgmentally notice experiences and accept them as they are without avoiding or exaggerating them when they saw a prompt on the screen instructing them to do so (Kuo et al., 2016; Erisman & Roemer, 2010). Finally, for the first phase of the "distract condition", participants were instructed to distract themselves from the emotion induction content by focusing on something neutral when they saw a prompt on the screen instructing them to do so. The purpose of attending to something neutral rather than positively-valenced thoughts was to prevent confounding distraction with positive emotion inductions (Kuo et al., 2016; Sheppes & Meiran, 2008). The order of the mindfulness and distract conditions were counterbalanced to control for possible order effects (react was always presented first). After the instruction phase, during the *baseline phase*, participants sat quietly for five minutes (i.e., 10 30-

second epochs) while baseline measurements were taken again. Next, at the *induction phase*, participants were played the recorded emotion induction script and were instructed to imagine themselves in the scenario for its duration (i.e., two minutes; four 30-second epochs) as vividly as possible. The pairing of the emotion induction script with condition was counterbalanced across participants. Next, at the *regulation phase*, participants were shown an on-screen prompt to implement the emotion regulation strategy that they were previously instructed in (i.e., react, mindfulness, distract) for 2.5 minutes (i.e., five 30-second epochs). The three phases of the study were repeated three times for each participant (i.e., until all three conditions and emotion induction scripts were completed). Emptiness was measured using the VAS after each *baseline*, emotion *induction*, and *regulation* phase. Self-reported, sympathetic (SCR), and parasympathetic (RSA) emotion was assessed continuously across the Baseline, Induction, and Regulation phases (Fitzpatrick et al., 2020). See Figure 1 for an overview of experimental phases in Fitzpatrick et al. (2020).

Figure 1

Overview of Experimental Phases in Fitzpatrick et al. (2020)



Note. RD = Rating Dial; SCR = Skin Conductance Response; RSA = Respiratory Sinus Arrhythmia; Emptiness = Emptiness measured via the Visual Analogue Scale. Following receiving instruction on one of the three emotion regulation strategies (React, Mindfulness, or

Distract), participants began the Baseline phase followed by the Induction phase, and finally the Regulation phase. Participants were measured on the RD, SCR, and RSA continuously across all three phases. Emptiness was measured after Baseline, after Induction, and following Regulation. At the Regulation phase, participants implemented one of the three emotion regulation strategies. This process was repeated three times for each participant, corresponding to each emotion regulation strategy.

Data Analytic Strategy

A series of Generalized Estimating Equations (GEEs; Liang & Zegler, 1986) analyses using SPSS version 27 were conducted. GEE is a semi-parametric extension of generalized linear modelling that is often used to control for within-subject covariance in non-Gaussian longitudinal or repeated measures data (Wang, 2014). GEE optimizes power by analyzing outcome variables collected within participants over time and retaining participants with missing data (Ballinger, 2004). For each analysis, autoregressive, exchangeable, and unstructured covariance structures were tested and the model with the lowest Quasilikelihood under the Independence Model Criterion (QIC) was selected. As is typical of SCR, it was a zero-inflated and positively skewed count variable (skewness = 2.45 (*SD* = .03) (Atkins & Gallop, 2007). Therefore, a negative binomial distribution was used for SCR data (Atkins & Gallop, 2007; Hilbe, 2011).

To address question 1, a GEE analysis examining whether group (i.e., BPD, GAD, HC) predicts emptiness during the 5-minute baseline periods prior to the induction phase. Group was the only predictor in these models.

To address question 2, a GEE analysis examining whether group predicts differences in emptiness reactivity was conducted with changes in emptiness from the baseline to the induction

phase as the outcome. Group and phase (baseline, induction) were entered as predictor variables. A Group × Phase interaction was also entered as a predictor to examine whether changes in emptiness from baseline to induction (i.e., emptiness reactivity) differs across groups.

To address question 3, a series of GEE analyses testing whether emptiness reactivity predicts emotion reactivity (indexed as changes in emotion from baseline to induction across self-report and physiological indices) and whether these effects varied across groups was conducted. Emptiness reactivity (i.e., rises in emptiness from baseline to induction), group, and phase (baseline, induction) were entered as predictor variables. Emptiness reactivity was calculated by subtracting emptiness at baseline from emptiness at induction. Each model included one of the three emotion reactivity outcome variables, namely RD, SCR, or RSA, which are indices of emotion measured across baseline and induction phases. An Emptiness Reactivity × Group x Phase interaction was also entered as a predictor for each index of emotion to examine whether the effect of emptiness reactivity on emotion reactivity differs across groups and phases. All lower-level two-way interactions required to build this higher order three-way interaction were entered into the model.

To address question 4, a GEE analysis examining whether specific emotion regulation strategies were more effective at reducing emptiness (and whether this effect varies across groups) was conducted with emptiness across the induction and regulation phases as the outcome. Group, phase (induction, regulation), and condition (i.e., react, mindfulness, distract) were entered as predictor variables to examine whether changes in emptiness varied as a function of group, phase, and condition, respectively. A Group × Phase × Condition interaction was also entered as a predictor to examine whether changes in emptiness from the induction phase to the

regulation phase (i.e., emptiness regulation) differs across emotion regulation strategies and groups. All lower-level interactions to build this interaction model were entered as predictors.

Results

Descriptive Statistics

See Table 1 for a summary of the means and standard deviations for emptiness, emptiness reactivity, and emotion (SCR, RD, RSA) across phases and groups.

Table 1

Means (standard deviations) of variables across groups

Variable	BPD	GAD	HC
Emptiness			
Baseline	39.19 (32.68)	21.84 (26.99)	2.72 (6.58)
Induction	58.22 (34.14)	44.26 (30.75)	29.81 (27.02)
Reactivity[1]	19.03 (31.72)	22.42 (27.29)	27.07 (26.36)
Regulation	47.28 (31.43)	30.48 (29.61)	11.88 (19.0)
React	52.08 (32.15)	34.80 (31.56)	10.00 (16.89)
Mindfulness	45.20 (33.38)	32.03 (29.00)	17.03 (23.30)
Distract	44.68 (28.76)	24.63 (27.94)	8.62 (15.23)
Rating Dial			
Baseline	4.18 (1.45)	4.43 (1.52)	5.18 (1.53)
Induction	2.91 (1.80)	3.10 (1.95)	4.01 (1.94)
Regulation	3.21 (1.97)	3.43 (1.93)	3.91 (1.84)
React	3.11 (1.81)	3.36 (1.73)	4.28 (1.58)
Mindfulness	3.19 (2.14)	3.40 (1.96)	3.67 (1.90)
Distract	3.35 (1.96)	3.35 (2.10)	3.79 (1.96)
SCR			
Baseline	1.61 (2.17)	1.71 (2.48)	1.27 (1.80)
Induction	1.96 (2.78)	1.96 (2.29)	1.56 (1.86)
Regulation	1.83 (2.23)	1.86 (2.15)	1.371.71)
React	1.84 (2.33)	1.84 (2.10)	1.41 (1.57)
Mindfulness	1.79 (1.87)	1.76 (2.04)	1.29 (1.73)
Distract	1.87 (2.49)	1.98 (2.32)	1.42 (1.84)
RSA			
Baseline	6.20 (1.40)	6.30 (1.15)	6.57 (1.22)
Induction	6.20 (1.41)	6.23 (1.18)	6.51 (1.26)
Regulation	6.33 (1.35)	6.47 (1.19)	6.60 (1.12)
React	6.38 (1.28)	6.49 (1.22)	6.62 (1.16)

Mindfulness	6.35 (1.46)	6.61 (1.16)	6.56 (1.07)
Distract	6.25 (1.29)	6.31 (1.16)	6.62 (1.14)

Note. BPD = Borderline Personality Disorder; GAD = Generalized Anxiety Disorder; HC = Healthy Controls; RD = Rating Dial; SCR = Skin Conductance Response; RSA= Respiratory Sinus Arrhythmia. Summary of the means and standard deviations for emptiness, emptiness reactivity, and emotion (SCR, RD, RSA) across phases and groups. [1]Emptiness reactivity = induction emptiness - baseline emptiness.

Group Predicting Baseline Emptiness

Table 2 includes the results of the GEE analyses examining group differences in baseline emptiness. There was a main effect of group in predicting baseline emptiness, χ^2 (2) = 77.546, p < .001. The parameter estimates of this analysis showed that the BPD group had higher levels of baseline emptiness compared to the HC group (B = 36.240, *SE* = 4.779), χ^2 (1) = 57.518, p < .001 and compared to the GAD group (B = 17.101, *SE* = 6.156), χ^2 (1) = 7.717, p = .005. The GAD group also had higher levels of baseline emptiness compared to the HC group, (B = 19.39, *SE* = 4.047), χ^2 (1) = 22.370, p < .001. Thus, baseline emptiness was highest for the BPD group, followed by the GAD group, and HCs.

Table 2

Generalized estimating equations analyses examining the effects of group in predicting baseline emptiness

Variable	B	SE	χ^2	*df*	*p*-value
Intercept	21.842	3.965	104.547	1	< .001
Group			77.576	2	< .001

Note. Parameter estimates were not reported for main effects with multiple levels and parameter estimates.

Group Predicting Emptiness Reactivity

Table 3 includes the results of the GEE analyses for the effects of group in predicting rises in emptiness from the baseline to the induction phase (i.e., emptiness reactivity). According to this analysis, there was a significant main effect of group in predicting emptiness across the baseline and induction phases, χ^2 (2) = 77.039, $p < .001$. Examination of parameter estimates revealed that the BPD group had higher levels of emptiness across the baseline and induction phases compared to the HC group (B = 36.208, *SE* = 4.793), χ^2 (1) = 57.060, $p < .001$ and the GAD group (B = 17.105, *SE* = 6.168), χ^2 (1) = 7.691, $p = .006$. In addition, the GAD group had higher levels of emptiness across the baseline and induction phases compared to the HC group (B = 19.103, *SE* = 4.046), χ^2 (1) = 22.290, $p <.001$. There was also a significant main effect of phase in predicting emptiness (B = 22.417, *SE* = 3.152), χ^2 (1) = 138.869, $p < .001$ such that emptiness was higher at the induction phase compared to the baseline phase. However, there was no significant interaction between group and phase in predicting emptiness χ^2 (2) = 2.709, $p = .258$. Therefore, while emptiness increases from the baseline to the induction phase in across groups (i.e., emptiness reactivity), the magnitude of emptiness reactivity does not differ across groups.

Table 3

Generalized estimating equations analyses examining the effects of group in predicting emptiness reactivity

Variable	B	SE	χ^2	*df*	*p*-value
Intercept	21.842	3.965	104.292	1	< .001
Group			77.039	2	< .001
Phase	22.417	3.152	138.869	1	< .001
Group × Phase			2.709	2	.258

Note. Parameter estimates were not reported for main effects with multiple levels and parameter estimates.

Group and Emptiness Reactivity Predicting Emotion Reactivity

Self-report. Table 4 includes the results of the GEE analyses examining whether emptiness reactivity (i.e., rises in emotion from the baseline phase to the induction phase) predicts RD reactivity, and whether this is moderated by group. The analysis revealed a main effect of group in predicting RD χ^2 (2) = 12.959, p = .002. Inspection of parameter estimates revealed that the BPD group had higher levels of RD compared to the HC group (B = 1.051, *SE* = .306), χ^2 (1) = 11.780, p = .001 but did not differ from the GAD group in RD, χ^2 (1) = .024, p = .877. In addition, the GAD group had higher levels of RD compared to the HC group (B = 1.006, *SE* = .344), χ^2 (1) = 8.573, p = .003. There was also a significant interaction between emptiness reactivity and phase in predicting RD, and inspection of parameter estimates revealed that as emptiness reactivity increased, RD reactivity increased (B = -.02, *SE* = .004), χ^2 (1) = 22.179, p < .001. Thus, greater increases in emptiness reactivity predicted greater increases in RD reactivity across groups. There was no significant interaction between group and emptiness reactivity in predicting RD reactivity χ^2 (2) = 3.664, p = .160, nor was there a significant interaction between group and phase in predicting RD reactivity χ^2 (2) = .974, p = .614. Finally, there was no significant three-way interaction between group, phase, and emptiness reactivity in predicting RD reactivity χ^2 (2) = 3.053, p = .217. Thus, while greater emptiness reactivity predicted greater RD reactivity, this effect was not moderated by group.

Table 4

Generalized estimating equations analyses examining the effects of group, phase, and emptiness reactivity in predicting self-reported emotional reactivity

Variable	B	SE	χ^2	*df*	*p*-value
Intercept	4.097	.234	1180.564	1	< .001
Group			12.959	2	.002
Phase	-.883	.197	77.358	1	< .001
Emptiness Reactivity			13.703	1	< .001
Group × Emptiness Reactivity			3.664	2	.160
Phase × Emptiness Reactivity	-.020	.004	22.179	1	< .001
Group × Phase			.974	2	.614
Group × Phase × Emptiness Reactivity			3.053	2	.217

Note. Parameter estimates were not reported for main effects and interactions with multiple levels and parameter estimates.

Sympathetic responding. Table 5 includes the results of the GEE analyses examining whether emptiness reactivity predicts SCR reactivity, and whether this is moderated by group. According to this analysis, there were no significant main effects or interactions of group, phase, or emptiness reactivity in predicting SCR reactivity.

Table 5

Generalized estimating equations analyses examining the effects of group, phase, and emptiness reactivity in predicting sympathetic emotional reactivity (skin conductance responses)

Variable	B	SE	χ^2	*df*	*p*-value
Intercept	.581	.162	24.507	1	< .001
Group			.369	2	.831
Phase	.110	.138	2.516	1	.113
Emptiness Reactivity			2.079	1	.149

Group × Emptiness Reactivity			.727	2	.695
Phase × Emptiness Reactivity	.003	.003	.314	1	.575
Group × Phase			.174	2	.917
Group × Phase × Emptiness Reactivity			.622	2	.733

Note. Parameter estimates were not reported for main effects with multiple levels and parameter estimates.

Parasympathetic responding. Table 6 includes the results of the GEE analyses examining whether emptiness reactivity predicts RSA and whether this is moderated by group. There was no significant main effect of group in predicting RSA reactivity χ^2 (2) = 2.528, p = .283. However, the analysis revealed a significant interaction between emptiness reactivity and phase in predicting RSA reactivity, and inspection of parameter estimates revealed that as emptiness reactivity increased, rises in RSA also increased (B = .005, *SE* = .002), χ^2 (1) = 4.974, p = .026. Thus, greater emptiness reactivity predicted increases in RSA across groups, which indicates *lower* emotion reactivity. However, there were no significant interactions between group and emptiness reactivity in predicting RSA reactivity χ^2 (2) = .365, p = .833, nor was there a significant interaction between group and phase in predicting RSA reactivity χ^2 (2) = 1.620, p = .445. Finally, there was no significant interaction between group, phase, and emptiness reactivity in predicting RSA, χ^2 (2) = 2.108, p = .348. Thus, while greater emptiness reactivity predicted greater increases in RSA (i.e., lower emotional reactivity), this effect was not moderated by group.

Table 6

Generalized estimating equations analyses examining the effects of group, phase, and emptiness reactivity in predicting parasympathetic emotional reactivity (respiratory sinus arrythmia)

Variable	B	SE	χ^2	*df*	*p*-value
Intercept	6.316	.168	3889.970	1	< .001
Group			2.528	2	.283
Phase	-.288	.070	19.072	1	< .001
Emptiness Reactivity	.001	.003	.086	1	.770
Group × Emptiness Reactivity			.365	2	.833
Phase × Emptiness Reactivity	.005	.002	4.974	1	.026
Group × Phase			1.620	2	.445
Group × Phase × Emptiness Reactivity			2.108	2	.348

Note. Parameter estimates were not reported for main effects and interactions with multiple levels and multiple parameter estimates.

Group and Emotion Regulation Strategy (Condition) Predicting Emptiness

Table 7 includes the results from the GEE analysis examining whether the regulation phase was associated with reductions in emptiness and whether this effect differs across condition (i.e., react, mindfulness and distract) and groups. The analysis revealed a significant main effect of group in predicting emptiness across the induction and regulation phases, χ^2 (2) = 7.038, p = .030. There was a trend towards the BPD group exhibiting higher emptiness across the induction and regulation phases compared to the HC group (B = 20.962, *SE* = 11.472), χ^2 (1) = 3.339, p = .068. However, the BPD group did not significantly differ in levels of emptiness compared to the GAD group, χ^2 (1) = .292 p = .589. There was also no significant difference between the GAD group and the HC group in levels of emptiness, χ^2 (1) = 1.813, p = .178. Moreover, there was no significant interaction between group and phase in predicting emptiness

χ^2 (2) = 4.106, p = .128. The results showed a significant interaction between condition and phase in predicting emptiness χ^2 (2) = 12.271, p = .002. Inspection of parameter estimates revealed that, across participant groups, the distract condition predicted greater reductions in emptiness from the induction to regulation phases compared to the react condition (B = -13.200, *SE* = 4.582), χ^2 (1) = 8.301, p = .004. However, there was no significant difference between the mindfulness condition and the react condition in predicting reductions in emptiness from the induction to regulation phases χ^2 (1) = 1.169, p = .280. In addition, while there was a trend towards there being greater reductions in emptiness in the distract condition compared to the mindfulness condition, this effect also did not reach statistical significance (B = 8.250*, SE* = 4.524), χ^2 (1) = 3.325, p = .068. Thus, the distract condition predicted greater reductions in emptiness compared to the react condition and, potentially, mindfulness condition, and the latter two did not differ from each other in predicting greater reductions in emptiness. There was no significant interaction between group and condition in predicting emptiness χ^2 (4) = 1.454, p = .835. Finally, there was no significant three-way interaction between group, condition, and phase in predicting emptiness, χ^2 (4) = 1.936, p = .747, indicating that the association between condition and emptiness across the induction and regulation phases was not moderated by group.

Table 7

Generalized estimating equations analyses examining the effects of emotion regulation strategies on emptiness across groups

Variable	B	SE	χ^2	*df*	*p*-value
Intercept	66.475	7.587	323.907	1	< .001
Group			7.038	2	.030
Phase	-19.172	3.033	111.888	1	< .001
Condition			9.113	2	.011
Group × Phase			4.106	2	.128

Condition × Phase	12.271	2	.002
Group × Condition	1.454	4	.835
Group × Condition × Phase	1.936	4	.747

Note. Parameter estimates were not reported for main effects and interactions with multiple levels and multiple parameter estimates.

Discussion

Feelings of emptiness are pervasive in BPD, representing one of the major diagnostic symptoms of the disorder (APA, 2013). Given its prevalence (Grilo & Udo, 2021), chronicity (Zanarini et al., 2016), and links to detrimental outcomes such as suicide and self-harm (e.g., Yen et al., 2021), there has been a growing interest in studying emptiness in BPD. Despite the burgeoning research on emptiness in general, no previous studies have specified which components of emptiness (i.e., baseline emptiness, emptiness reactivity) are elevated in BPD. The present study is the first to examine the emotion components of emptiness across BPD, GAD, and HC groups. The results revealed that baseline emptiness is higher in BPD compared to GAD and HC groups and that baseline emptiness is higher in the GAD group compared to the HC group. While emptiness increased in response to the emotion induction, the rate of this change (i.e., emptiness reactivity) was not significantly different across groups. In addition, greater emptiness reactivity predicted greater increases in self-report emotion (i.e., higher emotion reactivity) and RSA (i.e., lower emotion reactivity), and this effect also did not differ across groups. Emptiness reactivity did not significantly predict sympathetic reactivity. Finally, across groups, distraction as an emotion regulation strategy predicted greater reductions in emptiness compared to reacting as one normally would. While there were no other significant

differences found across emotion regulation strategies in reducing emptiness, a notable trend was that distraction was more effective in reducing emptiness compared to mindfulness, and mindfulness was more effective in reducing emptiness compared to simply reacting.

Baseline Emptiness

Given that emptiness is a diagnostic symptom of BPD (and not GAD), the finding that individuals with BPD experience higher emptiness at baseline compared to GAD and HC groups is not surprising. Additionally, given that both BPD and GAD are characterized by emotion dysregulation (Linehan, 1993; Turk et al., 2005), it is unsurprising that these groups would be higher in emptiness compared to HCs. However, the underlying mechanism for these observed group differences in baseline emptiness remains unknown. One possibility is that baseline emptiness is higher among groups characterized by greater emotion dysregulation, such as BPD and GAD (Linehan, 1993; Mennin et al., 2005). Furthermore, while there is scant research examining the differences in emotion dysregulation across BPD and GAD groups, empirical and theoretical research suggests that BPD represents a group with arguably the highest levels of emotion dysregulation (Carpenter & Trull, 2013; Selby et al., 2008; Selby & Joiner, 2009). This would be in line with a major tenet of Linehan's (1993) Biosocial model, which stipulates that emotion dysregulation represents the core of BPD that causes other symptoms such as emptiness. With regard to emptiness specifically, transactions between a biological vulnerability to emotion dysregulation and invalidating experiences in early life are suggested to lead to the inhibition of negative emotions in BPD (Linehan, 1993). Over time, the inhibition of negative emotions may become more habitual in BPD, leading to chronic emptiness. In this way, heightened baseline emptiness in BPD may reflect chronic emptiness in the disorder caused by an implicit attempt to downregulate emotion dysregulation. Although individuals with GAD may be characterized by

some elements of emotion dysregulation (Mennin et al., 2005), they may not experience it – and the invalidating environments that theoretically elicit it – to the same degree as those with BPD. Therefore, they may also experience less baseline emptiness than those with BPD, although still experience more than HCs. While this interpretation would align with Linehan's (1993) Biosocial model, it is important to note that this study did not assess for chronic emptiness, and only assessed for emptiness at the time of the experiment.

While group differences in baseline emptiness may be accounted for by degree of chronic inhibition of negative emotions, alternative explanations are plausible. Groups characterized by higher emotion dysregulation may experience more intense emotional activation, which may in turn lead to a subsequent depletion of emotions, which may be experienced as emptiness (Vohs & Schmeichel, 2003). According to the resource depletion model, one's ability to regulate their emotions can become fatigued or depleted after engagement in a self-regulation, which refers to an individual's capacity to regulate their own behaviours in accordance with goals or ideals (Vohs & Heatherton, 2000). Researchers have theorized that individuals have limited resources for self-regulation and that such resources can be depleted or fatigued by self-regulatory demands, such as intense emotional experiences (Baumeister & Heatherton, 1996). Given that individuals with BPD experience particularly heightened levels of baseline emotional intensity (e.g., Elices et al., 2012; Kuo & Linehan, 2009; Linehan, 1993), they may also experience particularly high levels of emotion depletion, followed by the GAD group, and finally, HCs. However, it is important to note that the original study did not demonstrate group differences in baseline emotion intensity in the BPD group relative to the GAD group (Fitzpatrick et al., 2020), and it is therefore unknown whether group differences in baseline emptiness is best explained by differences in emotion depletion.

Emptiness Reactivity

In addition to baseline emptiness, this is the first study to examine emptiness reactivity in BPD. Given that emptiness is suggested to arise in response to intense negative emotions (e.g., Didonna & Gonzalez, 2009), it is possible that emptiness increases in response to an emotional stressor and its associated emotion reactivity to a greater extent for individuals with BPD than others. Furthermore, individuals with BPD experience higher levels of emptiness during social interactions in close relationships (Stepp et al., 2009) and it is theorized that emptiness is related to feelings of social disconnection (Miller et al., 2020). Altogether, this research suggests that an interpersonally themed emotion induction such as a social rejection may effectively induce greater emptiness reactivity in BPD relative to other groups. Our findings suggest that emptiness does increase in response to a rejection-themed emotion induction, however the magnitude of this change did not differ across BPD, GAD, and HC groups. This was contrary to the expectation that emptiness reactivity would be highest for the BPD group compared to the GAD and HC groups.

The finding that emptiness reactivity is not particularly elevated in BPD follows a broader pattern of findings in the BPD and emotion dysregulation literature. In particular, while there is consistent evidence that BPD is associated with heightened baseline emotion intensity (e.g., Elices et al., 2012; Kuo & Linehan, 2009; Kuo et al., 2016), the results for heightened emotion reactivity in BPD are mixed (e.g., Baschnagel et al., 2013; Fitzpatrick et al., 2020; Scott et al., 2013). For example, while some literature suggests that BPD is associated with heightened self-reported emotion reactivity (e.g., Chapman et al., 2015; Dixon-Gordon et al., 2013), other studies suggest that self-reported emotion reactivity is not particularly elevated in BPD (e.g., Elices et al., 2012; Evans et al., 2013). If emptiness can be considered an emotion, then our

results would be consistent with the literature suggesting that emotion reactivity is not particularly heightened in BPD compared to other clinical groups. While the degree of change in emptiness from baseline to induction did not depend on group, the BPD group had the highest levels of emptiness at both baseline and induction. In a real-world setting, one's level of emptiness in response to a stressor may be a more useful treatment target rather than the degree to which emptiness is increased. Therefore, it may be beneficial to target emptiness *intensity* following a stressor rather than *reactivity,* in addition to baseline emptiness in BPD treatments.

Emptiness Reactivity and Emotion Reactivity

This study is also the first to examine the relation between emptiness and emotion reactivity across self-report and physiological emotion indices. With regard to self-report indices, emptiness reactivity predicted greater self-reported emotion reactivity. However, this effect did not differ across BPD, GAD, and HC groups. These results suggest that rises in emptiness are associated with higher subjective negative emotion in response to a stressor across groups. Given that the nature of the causal relationship between emptiness reactivity and self-report reactivity cannot be determined, these results are open to various interpretations. First, this may suggest that emptiness rises in response to negative emotion reactivity. This would be in line with the literature suggesting that emptiness functions as an emotion regulation strategy (e.g., Didonna & Gonzalez, 2009). In particular, once an intense negative emotion is experienced, emptiness may become activated in order to downregulate it, thereby serving an emotion regulation function. Alternatively, this result may suggest that intense negative emotions rise in response to increases in emptiness reactivity, which is aligned with literature suggesting that the experience of emptiness itself is distressing (e.g., Grilo & Udo, 2021). Another interpretation for this finding is that emptiness is an emotion, and hence, it may reflect another form of subjective emotional

reactivity, which would account for the association between emptiness reactivity and emotion reactivity in this study. While it is currently unclear whether emptiness is best conceptualized as an emotion, some literature suggests that there is conceptual overlap between emptiness and specific negative emotions, such as hopelessness and loneliness (D'Agostino et al., 2020; Miller et al., 2020). As such, higher levels of negative emotion reactivity in general (including hopelessness and loneliness) would be reflected by higher levels of emptiness reactivity as well. Finally, these results may be better accounted for by a combination of the above interpretations or a third variable that increases both emptiness and subjective negative emotion concurrently. Future research is needed to disentangle the causal relationship between emptiness and subjective negative emotion using longitudinal or EMA research methods.

In contrast to the findings for RD, emptiness reactivity was associated with *greater* increases in RSA, and hence, *lower* emotional reactivity in the parasympathetic domain, and this effect also did not differ across groups. Notably, this may align with the theoretical literature on the function of emptiness in BPD (Didonna & Gonzalez, 2009). According to Didonna and Gonzalez (2009), emptiness represents a maladaptive attempt to inhibit intense negative emotional experiences in BPD. These results also align with the findings in Klonsky (2008), which showed that emotion experts rate emptiness as high in negative affective valence but low in emotional arousal. Thus, this result may point to the function of emptiness and why it occurs so frequently in BPD, which is to downregulate emotion intensity by increasing activity in the parasympathetic nervous system (i.e., the emotion regulatory system; Austin et al., 2007). However, alternative explanations are also possible. For example, higher parasympathetic activity (i.e., lower emotion reactivity) may reflect increased engagement of the emotional regulation system, and as a result, this system is being activated in response to emptiness

reactivity to downregulate it. Furthermore, it is also possible that another unknown extraneous variable increases parasympathetic activation while simultaneously increasing emptiness reactivity, such as increased depression, which is associated with both high RSA and emptiness (Yaroslavsky et al., 2013; Miller et al., 2020). As with the results for self-report reactivity, more research is needed to determine the causal relationship between emptiness and parasympathetic emotion reactivity using longitudinal or EMA research methods.

The finding that the relationship between emptiness reactivity and emotion reactivity (across self-report, parasympathetic, and sympathetic measures) did not differ across groups was surprising. This result implies that the association between emptiness reactivity and emotion reactivity is the same across clinical groups. Given that emptiness and emotion dysregulation are core features of BPD (APA, 2013), it was expected that the relationship between emptiness reactivity and emotion reactivity would be more pronounced in BPD compared to those with GAD and HCs. Furthermore, given that both BPD and GAD are characterized by experiential avoidance and emotion dysregulation (Mennin et al., 2005; Newman & Llera, 2011), it was expected that the association between emptiness reactivity and emotion reactivity in these groups would be more pronounced compared to HCs. However, the lack of group effects may suggest that the *function* of emptiness may not be a distinguishing feature of BPD, although its levels at baseline might be. In addition to the lack of group differences, emptiness reactivity was not significantly associated with sympathetic emotion reactivity. Thus, emptiness reactivity may not influence sympathetic emotion reactivity as it does for parasympathetic and self-report emotion reactivity. One possibility is that emptiness reactivity may function to activate emotion regulatory systems via parasympathetic response rather than directly downregulating emotional systems via sympathetic response. Altogether, more research is needed to determine whether the

relationship between emptiness reactivity and emotion reactivity is consistent across clinical groups and whether sympathetic reactivity is impacted by emptiness reactivity.

Emotion Regulation Strategies and Emptiness

Given that emptiness is a subjectively distressing experience linked to suicidal behaviours (Grilo & Udo, 2021), it is crucial to identify optimal ways to reduce it. According to our results, engaging in an emotion regulation strategy may be useful in reducing emptiness. Specifically, the distract condition predicted greater reductions in emptiness from the induction phase to the regulation phase compared to the react condition. This suggests that directing attention away from one's emotions is more effective in reducing feelings of emptiness compared to simply reacting as one normally would. However, while there was a notable trend suggesting that distraction was associated with greater reductions in emptiness compared to mindfulness and that mindfulness was associated with greater reductions in emptiness compared to reacting, these differences were not statistically significant. These results were contrary to our expectation that mindfulness would be the most effective emotion regulation strategy because it directs attention towards emotions, allowing them to be processed and downregulated, as opposed to emptiness which is purported to have an emotional blunting effect that facilitates emotional avoidance (Didonna & Gonzalez, 2009; Sheppes & Meiran, 2008). Moreover, it was expected that distraction would be less effective and perhaps increase emptiness given that, like emptiness, it also directs attention away from emotional experiences, thereby preventing emotions from being processed and downregulated (Sheppes et al., 2011). One explanation for these findings is that distracting oneself is effective for downregulating emptiness in the short-term and perhaps less effective in processing and downregulating emptiness in the long-term. Distraction is considered to be an early-disengagement emotion regulation strategy such that it

works early in the emotion generative process by directing attention away from emotional stimuli, perhaps before emotion responses have even fully formed (Sheppes et al., 2011). Research suggests that distraction is more effective at downregulating high intensity emotions compared to emotion regulation strategies that require attending to emotional stimuli and processing emotional content, such as cognitive reappraisal or mindfulness (Sheppes & Meiran, 2008). Emotion regulation strategies that require more elaborative emotional processing such as mindfulness are potentially equally effective in downregulating low-intensity emotions in the short-term and are more effective in downregulating these emotions in the long-term because they facilitate emotional learning over time (Sheppes & Meiran, 2008). Given that emptiness is often associated with impulsive behaviours such as suicide and self-harm (e.g., Grilo & Udo, 2021), these behaviours may represent a form of distraction that effectively reduces intense emotions such as emptiness in the short-term, thereby reinforcing these behaviours. While the intensity of emptiness was not examined in the present study, it is possible that emptiness may be so aversive that it is always experienced as highly intense emotion. Thus, given its immediate and potent effectiveness for intense emotions, distraction may be a preferable strategy for reducing emptiness in the short-term. Conversely, mindfulness may be more effective in reducing low-intensity emptiness in the long term, and hence, more time (i.e., more than 2.5 minutes that was assessed in this study) may be needed to demonstrate its potentially long-term advantages over distraction. More research is needed to determine whether distraction and mindfulness emotion regulation strategies have differential effects on emptiness over time using longitudinal and EMA research designs.

Clinical Implications

A major clinical implication of the present study is that emptiness at rest, rather than lability, is characteristic of BPD. One clinical implication that follows from this is that BPD treatments should target baseline emptiness rather than the extent to which it rises following a stressor. There is some evidence that chronic emptiness can be reduced from BPD treatments such as DBT (Yen et al., 2009) and Systems Training for Emotional Predictability and Problem Solving (STEPPS; Black et al., 2018) using strategies such as enhancing feelings of social connection (Yen et al., 2009). As our findings demonstrate, teaching distraction in BPD treatments may be an effective intervention for reducing emptiness at least in the short-term, although its long-term benefits are uncertain. Clinicians may therefore advise individuals to use adaptive distraction skills in the short-term when emptiness is intense. Adaptive distraction strategies may include talking to a friend, taking a cold shower, or engaging in an enjoyable activity while avoiding maladaptive distraction strategies including self-harm or other impulsive behaviours (Selby et al., 2010). Given some evidence that mindfulness may be an advantageous emotion regulation strategy in the long-term among those who experience emptiness (Yen et al., 2009), mindfulness may be recommended for reducing low-intensity emptiness. However, as no studies have examined the direct effects of mindfulness on emptiness over time, it remains unknown whether mindfulness would indeed be the optimal strategy for reducing emptiness in the long-term. Nevertheless, a major implication of this finding is that the subtle, potentially ever-present effects of emptiness may be particularly profound for individuals with BPD, suggesting the need to target emptiness chronicity in clinical assessment and intervention.

Another clinical implication of this research is that rises in emptiness are associated with rises in subjective distress. As such, it is possible that clients (with BPD, GAD, or otherwise)

who experience rises in subjective distress may also be experiencing rises in emptiness and vice versa. Therefore, it may be beneficial to target both emptiness reactivity and negative emotion reactivity concurrently in treatment. It may also be prudent for clinicians to determine the temporal relationship between emptiness reactivity and negative emotion reactivity for specific clients in order to determine the sequencing and priority of different clinical targets. For example, if emptiness reactivity occurs prior to negative emotion reactivity, it may be beneficial to use distraction emotion regulation strategies to reduce emptiness and prevent negative emotion reactivity. Alternatively, if negative emotion reactivity occurs prior to emptiness reactivity, it may be beneficial to target negative emotion reactivity first perhaps through using distress tolerance skills, which may effectively downregulate intense emotions (Simons & Gaher, 2005; Zeifman et al., 2020) and prohibit the rise of emptiness. However, no previous research has examined the effectiveness of distress tolerance skills in the context of reducing emptiness reactivity.

Finally, given that emptiness reactivity was associated with increases in parasympathetic arousal in response to a stressor (and hence, decreases in emotion intensity), it may be useful for clinicians to consider the function of emptiness reactivity in their case formulations to determine alternative and potentially less destructive strategies for meeting this function. Indeed, teaching alternative ways to increase parasympathetic arousal may ultimately lead to reductions in emptiness given that the potential emotion regulatory function of emptiness reactivity could be replaced by a more adaptive means of increasing parasympathetic arousal. For individuals who experience emptiness reactivity, it may be beneficial to understand that emptiness may arise to serve an emotion regulatory function, which may be a cue to engage in more adaptive emotion regulation strategies. For example, one effective alternative for increasing parasympathetic

arousal is engaging in relaxation techniques (Lewis et al., 2015). Relaxation techniques may include deep breathing exercises, guided imagery, yoga, or meditation (Scotland-Coogan & Davis, 2016). While there is no evidence to suggest that relaxation techniques are effective in reducing emptiness directly, they may be incorporated into treatments to replace the potential function of emptiness in increasing parasympathetic emotional arousal in response to a stressor. However, clinicians are advised to carefully assess the function of emptiness to determine whether it is indeed emotion regulatory in nature for their particular clients.

Strengths and Limitations

There are several strengths of the present study. A major strength of this research is that this is the first study to examine the emotional correlates of emptiness using an experimental design. According to a recent meta-analysis by Miller et al. (2020), there are few studies that seek to examine the nature of emptiness in BPD, especially those using experimental designs. This study represents a crucial first step into understanding the nature of emptiness and provides insight into its possible function. Moreover, this study is the first to examine baseline emptiness and emptiness reactivity and compare these constructs across BPD, GAD, and HC groups. As a result, this study sheds light on how specific components of emptiness do or do not differ in BPD compared to other clinical groups. Another major strength of this research is that this study takes into account the multifaceted nature of emotions by using both self-report and physiological measures (Gross & John, 1997; Rosenthal et al., 2008). Indeed, previous research suggests that different indices of emotional responding are independent of each other, and therefore a comprehensive assessment of emotion requires using different methods (Rosenthal et al., 2008). The only other study examining the emotion components of emptiness exclusively measured valence and arousal levels of emptiness using expert judgments (Klonsky, 2008). This study

extends this research by comprehensively measuring the emotion components of emptiness within individuals who experience emptiness themselves. A final major strength of this study is that it is the first to examine how emptiness can be immediately reduced using specific emotion regulation strategies and which strategies are most effective. Previous studies have only examined reductions in emptiness following treatment rather than the effectiveness of specific strategies in directly reducing emptiness (e.g., Black et al., 2018; Yen et al., 2009). Thus, this study represents an important contribution to the literature on emptiness, providing insight into its nature, function in BPD and other clinical groups, and treatment strategies for reducing it.

While there are many strengths of this research, there are several important limitations to consider. First, the sample size within each clinical group was small (each $n = 40$). The modest sample size may have rendered this study underpowered to detect group differences in emptiness reactivity, the relationship between emptiness and emotion reactivity, and the effect of emotion regulation strategies on emptiness. Second, the present study only used a single item to assess emptiness, namely, a rating from 1-100 in response to "I feel empty" on the VAS. However, research suggests that single-item measures are generally less reliable compared to multi-item measures, and as such, it is suggested that emptiness is best measured using a multi-item scale (Price et al., 2020). For example, Price et al. (2020) developed a 5-item Subjective Emptiness Scale (SES), that defines emptiness as a sense of absence, aloneness, unfulfillment, and disconnection from self and others. Given the purported complexity of emptiness, it is possible that our current single-item measure did not adequately capture the construct. Third, while this study revealed significant associations between emptiness reactivity and emotion reactivity, it cannot be determined whether emptiness causes these changes or vice versa given that emptiness reactivity was not experimentally controlled for. Hence, while our results shed light on the

association between emptiness reactivity and emotion reactivity, the directionality of these relationships cannot be established, rendering these results open to various interpretations. Fourth, only one type of emotion induction was used (i.e., rejection-themed scripts). Therefore, it is unknown whether the impact of the emotion induction used is generalizable to other types of emotion inductions. For example, it is possible that emptiness may only be increased in response to interpersonally themed stressors given that some of the literature suggests that emptiness is related to a sense of social disconnection (e.g., Miller et al., 2020; Price et al., 2020). Finally, it is possible that there are limitations with the way emotions were measured in the present study. In particular, while RD, RSA, and SCR are empirically supported methods for measuring self-report, parasympathetic, and sympathetic emotion respectively (Rosenthal et al., 2008), there are other methods that could have been included to provide a more comprehensive assessment of emotion. For example, electromyography (EMG) is used to measure electrical activity produced by a nerve's muscle stimulation, which was not measured in the present study but may be useful for measuring behavioural domains of emotion (Balconi et al., 2011).

Future Directions

Given that the nature of emptiness in BPD remains largely understudied, there are some important future directions for further study. In general, more research is needed to examine the nature of emptiness and how it is experienced in BPD. One area of future research identified by Miller et al. (2020) is more qualitative research on how emptiness is subjectively experienced. In light of our findings, future research should further examine the subjective distress associated with emptiness, which may provide insight into how to best treat it. For example, if emptiness is associated with feelings of loneliness, emptiness may be best treated by enhancing one's social bonds. Another area of further study is to examine the causal relationship between stress,

emptiness reactivity, and emotion reactivity. As previously mentioned, the causal direction of the relationship between emptiness reactivity and emotion reactivity cannot be determined in the present study. Therefore, future research using EMA strategies or longitudinal designs are needed to disentangle these potentially causal relationships. Notably, it is important to determine whether the higher baseline emptiness in BPD found in the present study represents chronic emptiness that is common in the disorder. In addition to examining these effects over time, it would also be beneficial to examine whether emptiness leads to maladaptive outcomes. For example, previous research has demonstrated a robust association between emptiness and suicidality (e.g., Grilo & Udo, 2021; Yen et al., 2021), and therefore, it is crucial to determine whether emptiness causes these outcomes. Given that emptiness reactivity is associated with negative emotion reactivity and that distraction is most effective in reducing emptiness, individuals may engage in dangerous and impulsive behaviours as a maladaptive emotion regulation strategy. As such, future research using EMA designs is needed to determine whether there is a temporal relationship between intense negative emotions, emptiness, and suicidal behaviours. Given our results on effective strategies for reducing emptiness, future research is also needed to examine whether distraction strategies are indeed more effective in the short-term while mindfulness strategies are more effective in the long-term using EMA and longitudinal research designs. The effectiveness of other treatment strategies for reducing emptiness should also be explored in future studies. Finally, future research should seek to replicate the results of the present study using larger sample sizes, different emotion induction stimuli, and more comprehensive measures of emptiness.

Conclusion

In sum, BPD is characterized by higher baseline emptiness rather than emptiness reactivity, which may be reflective of chronic emptiness in the disorder. Moreover, emptiness is a complex phenomenon that has differential relationships with emotion reactivity. This study has important implications for the nature of emptiness in BPD and across clinical groups. Specifically, baseline emptiness is highest among individuals with BPD, followed by GAD, and finally HCs, which suggests that baseline emptiness may be proportionate to one's levels of emotion dysregulation. In addition, emptiness reactivity is associated with greater self-report emotion reactivity and greater parasympathetic activation (i.e., lower emotion reactivity), suggesting that emptiness reactivity may be like a double-edged sword: it is associated with both subjective distress and the engagement of emotion regulation systems in response to a stressor. Furthermore, this study is the first to demonstrate that emotion regulation strategies are effective for reducing emptiness. Distraction is a more effective strategy for reducing emptiness compared to mindfulness in the short-term, although research should examine whether mindfulness is more effective in the long-term. Future research is needed to further understand the complex phenomenon of emptiness in BPD, its relation to negative outcomes such as suicidal thoughts and behaviours, and how it can be effectively targeted in treatment.

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