Accepted Manuscript

This is an Accepted Manuscript of an article published by Taylor & Francis in Cognition and Emotions on December 26, 2025, available at https://doi.org/10.1080/02699931.2025.2608120.

Feeling Hollow: Examining the Presence and Emotional Correlates of Emptiness in Borderline Personality Disorder

Lindsay Fulham, MA, Skye Fitzpatrick, PhD

Department of Psychology, York University

Corresponding Author: Correspondence concerning this article should be addressed to Lindsay Fulham, Department of Psychology, York University, 4700 Keele Street, Toronto, Ontario, M3J 1P3, Canada. E-mail: lfulham@yorku.ca

Funding Details: This research was funded by the Ontario Council on Graduate Studies, Council of Ontario Universities (Ontario Graduate Scholarship), the Canadian Institutes of Health Research (grant number: 201210GSD-304038-229817), the American Psychological Association Dissertation Award, and the Ontario Mental Health Foundation Studentship Award.

Disclosure Statement: The authors report that there are no competing interests to declare.

Data Availability Statement: Aggregate data for this study are available from the corresponding author upon request.

Ethics Approval Statement: This research uses data from another study (Fitzpatrick et al., 2020) that was approved by the Toronto Metropolitan University ethics board (#2015-001).

Patient Consent Statement: All participants provided informed consent prior to their participation via signing a consent form.

ACCEPTED MANU

Abstract

Feelings of emptiness represent a common experience among individuals with borderline personality disorder (BPD) that are not well understood. Theoretical literature suggests that emptiness functions to downregulate intense emotional experiences in BPD, but this has not been tested. 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), and whether 2) emptiness reactivity predicts emotion reactivity across self-report, skin conductance response (SCR), and respiratory sinus arrhythmia (RSA) indices of emotion. Participants (N = 120) with BPD, generalized anxiety disorder (GAD), or HCs provided measurements of emptiness, self-reported emotion, SCR, and RSA at baseline and following a rejection-themed stressor. Results revealed that baseline emptiness was highest in the BPD group compared to the HC group and the GAD group. There were no significant group differences for emptiness reactivity. Overall, increases in emptiness predicted increases and decreases in emotional reactivity via self-report and RSA, respectively. These results suggest that higher baseline emptiness rather than emptiness reactivity is characteristic of BPD. Future research using longitudinal and ecological momentary assessment designs is needed to examine the causes of emptiness and how it can be effectively reduced.

Keywords: emptiness, borderline personality disorder, emotion reactivity, emotion dysregulation, parasympathetic emotion

ACCEPTED MANU

Feeling Hollow: Examining the Presence and Emotional Correlates of Emptiness in Borderline Personality Disorder

Borderline personality disorder (BPD) is a complex and life-threatening personality disorder such that approximately 63%-89% of people with BPD engage in self-injurious behaviour (American Psychiatric Association, 2022; Soloff et al., 1994) and up to 10% die by suicide (Gunderson, 2011). 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 (Miller et al., 2020). 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 and its relation to core emotional components of the disorder.

Emptiness in BPD

Chronic feelings of emptiness are listed as one of the nine diagnostic criteria for BPD (APA, 2022). In a nationally representative sample of individuals with BPD, the prevalence of chronic emptiness is around 68.4% (Grilo & Udo, 2021). Emptiness is often experienced as chronic and is among the slowest symptoms to remit in those with BPD compared to other symptoms of the disorder (Miller et al., 2020). Burgeoning research suggests that emptiness may be an especially problematic symptom for individuals with BPD that entails a host of negative sequelae or correlates (Ellison et al., 2016). Most crucially, emptiness is robustly associated with life-threatening outcomes such as self-harming and suicidal behaviours (e.g., Yen et al., 2021). In the general population, 67% of college students reported feeling empty prior to engaging in

ACCEPTED MANUSCRIPT

self-harm behaviours (Klonsky, 2008). Chronic emptiness is also associated with an increased odds of lifetime and past year suicide attempts in BPD (Grilo & Udo, 2021). Emptiness further predicts suicide attempts after a 10-year follow-up among those with BPD over and above other BPD symptoms (Yen et al., 2021). Collectively, these findings suggest that chronic emptiness is associated with an increased risk of suicide and self-harm, which may represent attempts to relieve feelings of emptiness in BPD (Grilo & Udo, 2021).

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 characterize BPD and thus require targeting in BPD treatments. One important consideration overlooked in previous research is the distinction between baseline emptiness and emptiness reactivity. *Baseline* emptiness refers to 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 emptiness in response to a given stimuli (e.g., emptiness following the introduction of a stressor). Given research suggesting that emptiness is associated with social disconnection (Miller et al., 2020), it is possible that an interpersonally themed emotion induction such as a social rejection may effectively induce emptiness reactivity. Additionally, while emptiness is elevated among individuals with BPD in general, little research has compared levels of emptiness across clinical groups and HCs, 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, and how emptiness could be targeted in treatment contexts (i.e., at baseline or in response to interpersonal stress). Considering negative outcomes, 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.

ACCEPTED MANUSCRIPT

Emptiness and Emotion Reactivity

The leading etiological theory of BPD known as the Biosocial Model (Linehan, 1993) has attempted to explain the development and maintenance of BPD symptoms including emptiness. Linehan (1993) theorized that invalidating responses to one's inner experiences in early life leads individuals to force themselves not to feel, which results in an emotional numbness or emptiness. Drawing from this, some theorists suggest that emptiness in BPD arises as a maladaptive form of emotion regulation that downregulates intense emotional experiences associated with the disorder (e.g., Didonna & Gonzalez, 2009). According to Didonna & Gonzalez (2009), emptiness is akin to experiential avoidance, which is the tendency to escape from unwanted emotional experiences and is considered a maladaptive coping strategy (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).

Despite the potential function of emptiness in downregulating emotion reactivity, the literature on the relationship between emptiness and emotional reactivity in BPD is scarce. One study found that experts in emotion research rated emptiness as high in negative affective *valence* but low in emotional *arousal* (Klonsky, 2008), aligning with the assertion that emptiness may dampen emotion arousal (or reactivity), thereby serving an emotion regulatory function (e.g., Didonna & Gonzalez, 2009). However, given that these findings were based on expert judgments, and that emotions are multifaceted encompassing both subjective and physiological domains (Rosenthal et al., 2008), probing the relationship between emptiness and emotional reactivity requires the assessment of emotion using both self-report and physiological methods (e.g., sympathetic and parasympathetic nervous system reactions). Sympathetic indices of

ACCEPTED MANUSCRIPT

emotion include skin conductance responses (SCR), which measure the electrical conductance from sweat secretion on the epidermis and has been linked to emotional arousal (Craske et al., 2008). Conversely, parasympathetic measures of emotion include respiratory sinus arrhythmia (RSA), which measures heart rate variability that is demonstrated to be a reliable proxy for parasympathetic influence on emotion after an emotion induction (Porges, 2007). Given that different indices of emotional responding are independent of each other (Rosenthal et al., 2008), 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), which is marked by excessive and uncontrollable anxiety or worry causing impairment in an individual's daily life (APA, 2022). Given that emotion dysregulation is pronounced in BPD, and that emptiness theoretically develops as a method of regulating emotions, the emotional dampening effects of emptiness may be greater in BPD than in other clinical groups like GAD. However, such assertions have not been studied. Comparing the relationship between emptiness on emotional reactivity across BPD, GAD, and HCs 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.

Current Study

In summary, research on emptiness in BPD remains scarce and it is unclear which components of emptiness (i.e., baseline or reactivity) are elevated in the disorder. According to

ACCEPTED MANUSCRIPT

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; 2) whether BPD is characterized by elevated emptiness reactivity relative to individuals with GAD and HCs; 3) whether increases in emptiness are associated with decreases in emotional responding and 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 BPD will be associated with higher baseline emptiness and higher emptiness reactivity (i.e., rises in emptiness after an emotion induction) compared to GAD and HCs. We further hypothesized that increases in emptiness will predict lower emotional reactivity across physiological and self-report indices and that this association will be more pronounced in BPD compared to GAD and HCs.

Materials and Methods

Participants

The present 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) that were comparable in age and sex were recruited online and through the distribution of fliers. In line with other BPD studies (e.g., Kuo & Linehan, 2009), the exclusion criteria consisted of having health conditions or taking several medications that influence

ACCEPTED MANUSCRIPT

psychophysiology and task completion, including several comorbid medical (e.g., heart/respiratory conditions) and psychiatric conditions (e.g., severe psychotic disorder). 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 BPD criterion. HCs were excluded if they endorsed current psychiatric diagnoses or taking any psychiatric medications. See Supplementary Materials for sample demographics and comorbidities across groups.

Measures

Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders-IV-TR (SCID-IV-TR; First et al., 2002). The SCID is a semi-structured clinical interview that is widely used for detecting current and lifetime psychiatric disorders in the DSM-5-TR (APA, 2022) and was used to assess for GAD and diagnostic comorbidities. Moreover, the SCID-IV-TR severity dimensions show excellent levels of internal consistency (all Cronbach's αs >.80), test-retest reliability, concurrent, and predictive validity (Shankman et al., 2018). The prevalence-adjusted bias-adjusted kappas (PABAKs) 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 is a semi-structured interview that was used to assess for the presence of BPD. It has good to excellent levels of interrater reliability for diagnoses of BPD (Carcone et al., 2015). The average PABAK value across assessors with the gold standard assessor for IPDE-BPE was .95 (Fitzpatrick et al., 2020).

Emptiness. A Visual Analogue Scale (VAS) was used to assess emptiness, whereby 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. Previous

ACCEPTED MANUSCRIPT

research on the VAS has reported its inter-item reliability and convergent validity (Stern et al., 1997). VAS data were carefully cleaned and checked for impossible responses.

Emotion Indices

Self-reported emotional intensity. Self-reported emotional intensity was indexed as participant ratings using a continuous rating dial (RD; Levenson & Ruef, 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). 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. Self-reported data were carefully cleaned and checked for impossible responses.

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). Electrodes were placed on the medial middle and index fingertips of each participant's non-dominant hand. 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 and cleaned 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, which 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 and is used to quantify vagal tone (Porges, 2007). RSA is

ACCEPTED MANUSCRIPT

quantified as a proxy for parasympathetic influences on emotion, including assessing vagal withdrawal (i.e., decreases in RSA) as an indicator of higher emotional reactivity (Porges, 2007).

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. The electrocardiogram was then decomposed into three frequency ranges using spectral analysis. 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 clean the data and calculate spectral densities with this high frequency band continuously across 30-second epochs.

Emotion Induction

Three 2-minute rejection-themed scripts standardized on number of thoughts, physiological sensations, and number of emotion words were developed in Fitzpatrick et al. (2020) to induce emotion. Scripts involved scenarios of rejection from either a 1) mother, 2) friend, and 3) romantic partner (see open science framework for more information on script development: https://osf.io/cqaj2/). 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 Fitzpatrick et al. (2020), interested participants were pre-screened online and over the phone. 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. Only the baseline and induction phases were used for the present study (see

ACCEPTED MANUSCRIPT

Supplementary Materials for a complete summary of experimental procedures in Fitzpatrick et al., 2020). During the *baseline phase*, participants sat quietly for five minutes (i.e., 10 30-second epochs) while baseline measurements were taken. 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. All phases of the study were repeated three times for each participant until all emotion induction scripts were completed. The order of the induction scripts was counterbalanced across participants. Emptiness was measured using the VAS after each *baseline* and *induction* phase and self-reported (i.e., RD), SCR, and RSA were assessed continuously across phases (Fitzpatrick et al., 2020).

Data Analytic Strategy

A series of Generalized Estimating Equations (GEEs; Liang & Zegler, 1986) analyses were conducted. GEE is a semi-parametric extension of generalized linear modelling used to control for within-subject covariance in non-Gaussian repeated measures data while optimizing power and retaining participants with missing data (Liang & Zegler, 1986). Each analysis tested autoregressive, exchangeable, and unstructured covariance structures and the model with the lowest Quasilikelihood under the Independence Model Criterion (QIC) was selected. SCR was a zero-inflated and positively skewed count variable (skewness = 2.45 (*SD* = .03). Therefore, a negative binomial distribution was used for SCR data.

To address question 1, a GEE analysis examining whether group (i.e., BPD, GAD, HC) predicts emptiness during the baseline 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

ACCEPTED MANUSCRIPT

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 (i.e., changes in emotion from baseline to induction across RD, SCR, and RSA) 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 (i.e., RD, SCR, or RSA). An Emptiness Reactivity × Group x Phase interaction was also entered as a predictor 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.

Results

Descriptive Statistics

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

Group Predicting Baseline Emptiness

Table 1 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. Parameter estimates 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 had higher

ACCEPTED MANUSCRIPT

baseline emptiness compared HCs, (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.

Group Predicting Emptiness Reactivity

Table 1 includes the results of the GEE analyses for the effects of group in predicting rises in emptiness from baseline to induction (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, $p = .006$. 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. 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.

Group and Emptiness Reactivity Predicting Emotion Reactivity

Self-report. Table 2 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 emotion reactivity across emotion indices (RD, SCR, RSA) 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

ACCEPTED MANUSCRIPT

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. 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 parameter estimates revealed that as emptiness reactivity increased, RD reactivity increased (B = -.02, *SE* = .004), χ^2 (1) = 22.179, *p* < .001. There was no significant interaction between group and emptiness reactivity in predicting RD reactivity, nor was there a significant interaction between group and phase in predicting RD reactivity. Finally, there was no significant three-way interaction between group, phase, and emptiness reactivity in predicting RD reactivity. Thus, while greater emptiness reactivity predicted greater RD reactivity, this effect was not moderated by group.

Sympathetic responding. With regard to SCR, there were no significant main effects or interactions of group, phase, or emptiness reactivity in predicting SCR reactivity.

Parasympathetic responding. There was no significant main effect of group in predicting RSA reactivity. The analysis revealed a significant interaction between emptiness reactivity and phase in predicting RSA reactivity, and parameter estimates showed that as emptiness reactivity increased, rises in RSA also increased (B = .005, *SE* = .002), χ^2 (1) = 4.974, *p* = .026. There were no significant interactions between group and emptiness reactivity in predicting RSA reactivity, nor a significant interaction between group and phase in predicting RSA reactivity. Finally, there was no significant interaction between group, phase, and emptiness reactivity in predicting RSA. Thus, while greater emptiness reactivity predicted greater increases in RSA (i.e., lower emotional reactivity), this effect was not moderated by group.

ACCEPTED MANUSCRIPT

Discussion

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. 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.

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 unsurprising. However, the underlying mechanism for these observed group differences in baseline emptiness remains unknown. One possibility is that emotion dysregulation represents the core of BPD that causes other symptoms such as emptiness (Linehan, 1993). Transactions between a biological vulnerability to emotion dysregulation and early invalidating experiences are suggested to lead to the inhibition of negative emotions in BPD, leading to chronic emptiness (Linehan, 1993). While those with GAD may suffer from emotion dysregulation, they may not experience it – and the factors that theoretically elicit it – to the same degree as those with BPD. Thus, they may experience less baseline emptiness than those with BPD, although still experience more than HCs.

In addition to baseline emptiness, this is the first study to examine emptiness reactivity in BPD. 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

ACCEPTED MANUSCRIPT

HC groups. This finding follows a broader pattern of findings in the BPD and emotion dysregulation literature. While there is consistent evidence that BPD is associated with heightened baseline emotion intensity (e.g., Kuo & Linehan, 2009), the results for heightened emotion reactivity in BPD are mixed (e.g., Fitzpatrick et al., 2020). Although 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. Therefore, it may be beneficial for clinicians to target emptiness *intensity* following a stressor rather than *reactivity,* in addition to baseline emptiness.

This study is also the first to examine the relation between emptiness and emotion reactivity across self-report and physiological emotion indices. Emptiness reactivity predicted greater self-reported emotion reactivity, but this effect did not differ across BPD, GAD, and HC groups. Thus, across groups, rises in emptiness are associated with higher subjective negative emotion in response to a stressor. One explanation is that emptiness rises in response to negative emotion reactivity, which would align with the literature suggesting that emptiness functions as an emotion regulation strategy (e.g., Didonna & Gonzalez, 2009). When an intense negative emotion is experienced, emptiness may activate in order to downregulate it, thereby serving an emotion regulation function. Alternatively, intense negative emotions may rise in response to increases in emptiness reactivity, which is consistent with the finding that emptiness is a distressing experience (e.g., Grilo & Udo, 2021). Research is needed to disentangle causal relationships between emptiness and subjective negative emotion using longitudinal or EMA methods.

In contrast to the findings for self-reported emotion reactivity, emptiness reactivity was associated with *greater* increases in RSA, and hence, *lower* emotional reactivity in the

ACCEPTED MANUSCRIPT

parasympathetic domain, and this effect also did not differ across groups. Notably, this may align with the theoretical literature suggesting that emptiness functions to inhibit intense negative emotional experiences in BPD (Didonna & Gonzalez, 2009). Thus, it is possible that emptiness functions to downregulate emotion intensity by increasing activity in the parasympathetic nervous system. However, it is also possible that higher parasympathetic activity reflects increased engagement of the emotional regulation system, and as such, this system is being activated in response to emptiness reactivity to downregulate it. This further highlights the need for longitudinal or EMA research methods to disentangle these relationships.

The finding that the relationship between emptiness reactivity and emotion reactivity did not differ across groups was inconsistent with hypotheses. The lack of group effects may suggest that the *function* of emptiness may not be a distinguishing feature of BPD, although its intensity at baseline might be. Along with 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-reported emotion reactivity. Further research is needed to replicate these findings.

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 and using specific strategies such as enhancing feelings of social connection (Yen et al., 2009). One study suggests that mindfulness may be an effective emotion regulation strategy for reducing emptiness given that it works in opposition to emptiness by directing

ACCEPTED MANUSCRIPT

attention towards emotions rather than away from them or 'numbing' them (Didonna & Gonzalez, 2009). Another clinical implication of this research is that those who experience rises in subjective distress may also be experiencing rises in emptiness and vice versa. Therefore, it may be beneficial to treat both emptiness reactivity and negative emotion reactivity concurrently and establish their temporal relationship for specific clients to determine the sequencing and priority of different clinical targets. Finally, given that emptiness reactivity was associated with increases in parasympathetic arousal in response to a stressor, it may be useful for clinicians to consider the function of emptiness reactivity in their case formulations and encourage alternative, less destructive strategies for fulfilling those functions. For example, one alternative for increasing parasympathetic arousal is engaging in relaxation techniques such as deep breathing exercises, guided imagery, or meditation (Didonna & Gonzalez, 2009). While there is little evidence that relaxation techniques reduce emptiness directly, they may be incorporated into treatments to replace the function of emptiness in increasing parasympathetic emotional arousal in response to a stressor.

Strengths and Limitations

A major strength of this research is that this is the first study to examine the emotional correlates of emptiness across different clinical groups using an experimental design, which is currently lacking in the literature (Miller et al., 2020). This study represents a crucial first step for understanding the nature of emptiness and provides insight into its possible function. Another major strength is that this study takes into account the multifaceted nature of emotions by using both self-report and physiological measures (Rosenthal et al., 2008). This study also extends previous research by comprehensively measuring the emotion components of emptiness within individuals who experience emptiness themselves.

ACCEPTED MANUSCRIPT

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 $n = 40$), which may have rendered this study underpowered to detect group differences. 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. Single-item measures may be generally less reliable compared to multi-item measures, and as such, emptiness may be best measured using a multi-item scale. 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.

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, suggesting that emptiness reactivity may be like a double-edged sword: it is both subjectively distressing yet activates emotion regulation systems in response to a stressor. Future research is needed to further understand the

ACCEPTED MANUSCRIPT

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.

ACCEPTED MANUSCRIPT

Acknowledgments

We thank Sonya Varma and Dr. Janice Kuo for assisting in data collection procedures for the present study. We also thank our participants for their willingness to share their experiences and contribute to this research.

ACCEPTED MANUSCRIPT

References

American Psychiatric Association. (2022). Diagnostic and statistical manual of mental disorders (5th ed., text rev.). https://doi.org/10.1176/appi.books.9780890425787

Carcone, D., Tokarz, V. L., & Ruocco, A. C. (2015). A systematic review on the reliability and validity of semistructured diagnostic interviews for borderline personality disorder. *Canadian Psychology/Psychologie Canadienne, 56*(2), 208–226. https://doi.org/10.1037/cap0000026

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy, 46*(1), 5–27. https://doi.org/10.1016/j.brat.2007.10.003

Didonna, F., & Gonzalez, Y. R. (2009). Mindfulness and feelings of emptiness. In F. Didonna (Ed.), *Clinical handbook of mindfulness* (pp. 125–151). Springer Science + Business Media. https://doi.org/10.1007/978-0-387-09593-6_9

Ellison, W. D., Rosenstein, L., Chelminski, I., Dalrymple, K., & Zimmerman, M. (2016). The clinical significance of single features of borderline personality disorder: Anger, affective instability, impulsivity, and chronic emptiness in psychiatric outpatients. *Journal of Personality Disorders, 30*(2), 261–270. https://doi.org/10.1521/pedi_2015_29_193

First, M., Spitzer, R., Gibbon, M., & Williams, J. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition (SCID-I/P)*. New York, NY: Biometrics Research Department, New York State Psychiatric Institute. https://doi.org/10.1007/978-981-287-087-2_80-1

Fitzpatrick, S., Varma, S., & Kuo, J. R. (2020). Is borderline personality disorder really an emotion dysregulation disorder and, if so, how? A comprehensive experimental paradigm.

ACCEPTED MANUSCRIPT

Psychological Medicine, 1–13. Advance online publication. https://doi.org/10.1017/S0033291720004225

Grilo, C. M., & Udo, T. (2021). Association of borderline personality disorder criteria with suicide attempts among US adults. *JAMA Network Open, 4*(5), e219389. https://doi.org/10.1001/jamanetworkopen.2021.9389

Gunderson, J. G. (2011). Borderline personality disorder. *New England Journal of Medicine, 364*(21), 2037-2042. https://doi.org/10.1056/NEJMcp1007358

Hayes, S. C., Wilson, K. G., Gifford, E. V., Follette, V. M., & Strosahl, K. (1996). Experiential avoidance and behavioral disorders: A functional dimensional approach to diagnosis and treatment. *Journal of Consulting and Clinical Psychology, 64*(6), 1152–1168. https://doi.org/10.1037/0022-006X.64.6.1152

Klonsky E. D. (2008). What is emptiness? Clarifying the 7th criterion for borderline personality disorder. *Journal of Personality Disorders, 22*(4), 418–426. https://doi.org/10.1521/pedi.2008.22.4.418

Kuo, J. R., & Linehan, M. M. (2009). Disentangling emotion processes in borderline personality disorder: Physiological and self-reported assessment of biological vulnerability, baseline intensitfmily, and reactivity to emotionally evocative stimuli. *Journal of Abnormal Psychology, 118*, 531–544. https://doi.org/10.1037/a0016392

Levenson, R. W., & Ruef, A. M. (1992). Empathy: A physiological substrate. *Journal of Personality and Social Psychology, 63*(2), 234–246. https://doi.org/10.1037/0022-3514.63.2.234

Liang, K., & Zegler, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika, 78*(1), 13-22. https://doi.org/10.2307/2336267

ACCEPTED MANUSCRIPT

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

Loranger, A. W., Sartorius, N., Andreoli, A., Berger, P., Buchheim, P., Channabasavanna, S. M., ...Regier, D. A. (1994). The international personality disorder examination: The world health Organization/Alcohol, drug abuse, and mental health administration international pilot study of personality disorders. *Archives of General Psychiatry, 51*, 215-224. https://doi.org/10.1001/archpsyc.1994.03950030051005

Mennin, D. S., Heimberg, R. G., Turk, C. L., & Fresco, D. M. (2005). Preliminary evidence for an emotion dysregulation model of generalized anxiety disorder. *Behaviour Research and Therapy, 43*(10), 1281–1310. https://doi.org/10.1016/j.brat.2004.08.008

Miller, C. E., Townsend, M. L., Day, N., & Grenyer, B. (2020). Measuring the shadows: A systematic review of chronic emptiness in borderline personality disorder. *PloS One, 15*(7), e0233970. https://doi.org/10.1371/journal.pone.0233970

Porges S. W. (2007). The polyvagal perspective. *Biological psychology, 74*(2), 116–143. https://doi.org/10.1016/j.biopsycho.2006.06.009

Rosenthal, M. Z., Gratz, K. L., Kosson, D. S., Cheavens, J. S., Lejuez, C. W., & Lynch, T. R. (2008). Borderline personality disorder and emotional responding: A review of the research literature. *Clinical Psychology Review, 28*(1), 75–91. https://doi.org/10.1016/j.cpr.2007.04.001

Shankman, S. A., Funkhouser, C. J., Klein, D. N., Davila, J., Lerner, D., & Hee, D. (2018). Reliability and validity of severity dimensions of psychopathology assessed using the Structured Clinical Interview for DSM-5 (SCID). *International Journal of Methods in Psychiatric Research, 27*(1), e1590. https://doi.org/10.1002/mpr.1590

ACCEPTED MANUSCRIPT

Soloff, P. H., Lis, J. A., Kelly, T., Cornelius, J., & Ulrich, R. (1994). Risk factors for suicidal behavior in borderline personality disorder. *The American Journal of Psychiatry, 151*(9), 1316-1323. https://doi.org/10.1176/ajp.151.9.1316

Stern, R. A., Arruda, J. E., Hooper, C. R., Wolfner, G. D., & Morey, C. E. (1997). Visual analogue mood scales to measure internal mood state in neurologically impaired patients: Description and initial validity evidence. *Aphasiology, 11*(1), 59–71. https://doi.org/10.1080/02687039708248455

Yen, S., Johnson, J., Costello, E., & Simpson, E. B. (2009). A 5-day dialectical behavior therapy partial hospital program for women with borderline personality disorder: Predictors of outcome from a 3-month follow-up study. *Journal of Psychiatric Practice, 15*(3), 173–182. https://doi.org/10.1097/01.pra.0000351877.45260.70

Yen, S., Peters, J. R., Nishar, S., Grilo, C. M., Sanislow, C. A., Shea, M. T., Zanarini, M. C., McGlashan, T. H., Morey, L. C., & Skodol, A. E. (2021). Association of borderline personality disorder criteria with suicide attempts: Findings from the collaborative longitudinal study of personality disorders over 10 years of follow-up. *JAMA Psychiatry, 78*(2), 187–194. https://doi.org/10.1001/jamapsychiatry.2020.3598

ACCEPTED MANUSCRIPT

Table 1

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

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

ACCEPTED MANUSCRIPT

Table 2

Generalized estimating equations analyses examining the effects of group, phase, and emptiness reactivity in predicting RD, SCR, and RSA

Variable	B	SE	χ^2	*df*	*p*-value
RD					
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
SCR					
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
RSA					
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. RD = rating dial; SCR = skin conductance responses; RSA = respiratory sinus arrhythmia

ACCEPTED MANUSCRIPT